

# Designing for energy transition through Value Sensitive Design



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*Designers can do much for a more sustainable future. Sustainability transitions research and empirical assessment of its course in a specific context can be used to identify a relevant space-time for different design initiatives. We explore this reasoning in advancing solar photovoltaics in heritage, where a loss of aesthetic qualities and the heritage value of buildings may curb where solar arrays are sited. By using the Value Sensitive Design framework we illustrate how a working compromise among the seemingly conflicting values involved can be found. The value mix used and the resulting concept informs solar proponents in siting solar in culturally sensitive ways and shows the heritage constituency that solar technology does not categorically mean a misfit with cultural heritage.*

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Through its capacity to envision future goods and services, design has the potential to change production and consumption patterns for the better (Papanek, 1971). The increasing complexity of global problems requires new and better solutions from designers and, by implication, sustainability needs a creative force (Papanek, 1971). Many approaches have been developed for the task, ranging from Fuller's anticipatory design realized through his design science revolution (Fuller, 1964; 1982; Fuller & McHale, 1963) to Manzini and Vessoli's (2003) and Meroni's (2006) strategic design for sustainability by generating long-lasting outcomes for future improvement. Yet sustainable design initiatives easily fall short of their desired outcomes. Hoogma, Kemp, Schot, and Truffer (2002) illustrate the problem well through reminding us of the hundreds of elegant, critical, futuristic, plausible as and production-ready electric concept cars that have been designed and displayed in fairs for decades, yet there has only been a very meagre change in the road transit system as yet. Just producing a better design appears to not be enough.

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A prime reason behind the frequent curbing of the effects of sustainable design lies in socio-technical interdependencies. As Elizabeth Shove and her colleagues (Shove, Pantzar, & Watson, 2012) formulate it, our everyday work

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and consumption practices are comprised of interdependent elements, and attempts to change any one isolated element typically results in the changed element snapping back to the original constellation like an atom in a force field (Hughes, 1983). The issue of interdependencies is further aggregated in large sociotechnical systems, such as the road transit or energy system, where technology interlinkages, standards, massive sunk costs, legislation and user habits have created strong interlinked path dependencies (Geels & Schot, 2007; Hoogma et al., 2002). Electric cars or renewable energy technologies can only prosper with associated changes in the other elements that comprise their sociotechnical environment.

The import of systemic interdependencies in practice and system levels appears difficult for many designers to come to terms with – if change is so brutally difficult to achieve what room is there for creative efforts? In this paper we argue that designers can do much for a more sustainable future within large sociotechnical systems, yet this requires that sustainable design needs to pay attention to how it is positioned strategically and the principles for working this strategy have to be adequate to the task at hand. We describe how sustainability transitions research and empirical assessment of its course in a specific context can be used to identify a relevant space-time for different design initiatives and moments when even relatively modest efforts can make an addition to an ongoing sustainability transition.

The empirical setting we discuss is the furthering of solar energy in Finland. The Finnish energy system currently has low levels of intermittent renewables compared to its Scandinavian neighbours, despite its commitments to a reduction in carbon emissions by 2020. Due to its arctic location the carbon footprint per capita in the Finnish energy system was 8.5 metric tons per capita in 2013, in globally mid range with annual reduction trend of 5–7%. Despite endorsed targets to increase the share of wind energy (4,6% in 2016) and solar energy (0,06% in 2016) in electricity production, the uptake of these technologies has been slow. Below we present a brief analysis of the current state and the time-space it holds for design intervention to further it.

### *1 Sustainable energy transition and forms of strategic design*

The solar photovoltaic (PV) module price has come to reach ‘grid parity’ (the economic viability of investment in comparison to electricity’s price in an average module lifetime) for use in both residential and industrial settings in Finland given own use and thus no transmission network fees or taxes (FinSolar, 2017). The proliferation of solar technology is increasing rapidly with repeated doubling of annual installation amounts, but is still remains slow in comparison to other Scandinavian countries, hampered by a lack of net metering or feed-in tariff, the import taxation level and the bureaucracy involved in setting up solar installations (FinSolar, 2017; Pasonen, Mäkinen,

Alanen, & Sipilä, 2012; Šúri, Huld, Dunlop, & Ossenbrink, 2007). The low market penetration further means relative inefficiency in ordering solar modules and installation services, resulting in the ‘soft costs’ of solar being over double those in Germany and accounting for over half of the price of a functional solar installation (FinSolar, 2017).

Transitions literature posits that systems change requires alternatives (from emerging niches) that agglomerate to a position that can challenge or reconfigure the sociotechnical field (Geels & Schot, 2007; Ornetzeder & Rohracher, 2013) (Figure 1 shows the co-evolutionary dynamics and niches projection in the systems). System change proceeds through gradually overcoming barriers that prohibit the new system from proliferating in the sociotechnical terrain built for previous technologies (Hughes, 1983). Hughes highlights ‘reverse salients’ as being particularly important: the identification and eradication of such features of a sociotechnical environment that hold back the advancing of a new sociotechnical system. Similar ideas feature in transition governance (Verbong & Loorbach, 2012). The barrier removal initiatives ongoing in Finland include establishing a record of installation costs to combat uncertainty and incredulity towards falling prices, a campaign to raise the size of import tax excepted systems, developing the services for calculating solar yield, installation costs and services, the ease and the standardization of permitting across municipalities, and so on. In this view, the chicken-and-egg situation (of market size; and the price and ease of acquiring solar in the Finnish market) will not be eradicated by any one measure, even if the steady annual solar module’s price drop greatly facilitates it – after all, most of the costs come from the installation and services.

These measures illustrate the nature of strategic action in sustainability transitions: advancing the system change will not take place through any one isolated regulatory action or design project but rather it will proceed through concerted efforts to change the array of system conditions that need to be changed in order for the new sustainable solutions to proceed. Such strategy is determined not by an abstract sustainable cause, nor by the self-interest of any one company (as is the usual case with strategic design). The system transition analysis sets the strategic direction and vision, and tactical engagement points become the common interest of actors seeking to foster the transition, rather than their particular commercial or public interests. This framing of action has its corollary in the timing and spacing of interventions. Due to its complex and contingent interfacing points with previous systems and power holders, the interventions needed for systems change cannot be reliably pre-planned for the entire course of system transition but rather preplanned for foreseeable future projections, typically at multiple timeframes.

This frame of reference opens up some new vistas for strategic design. To be strategically important, sustainable design need not be limited to long-range

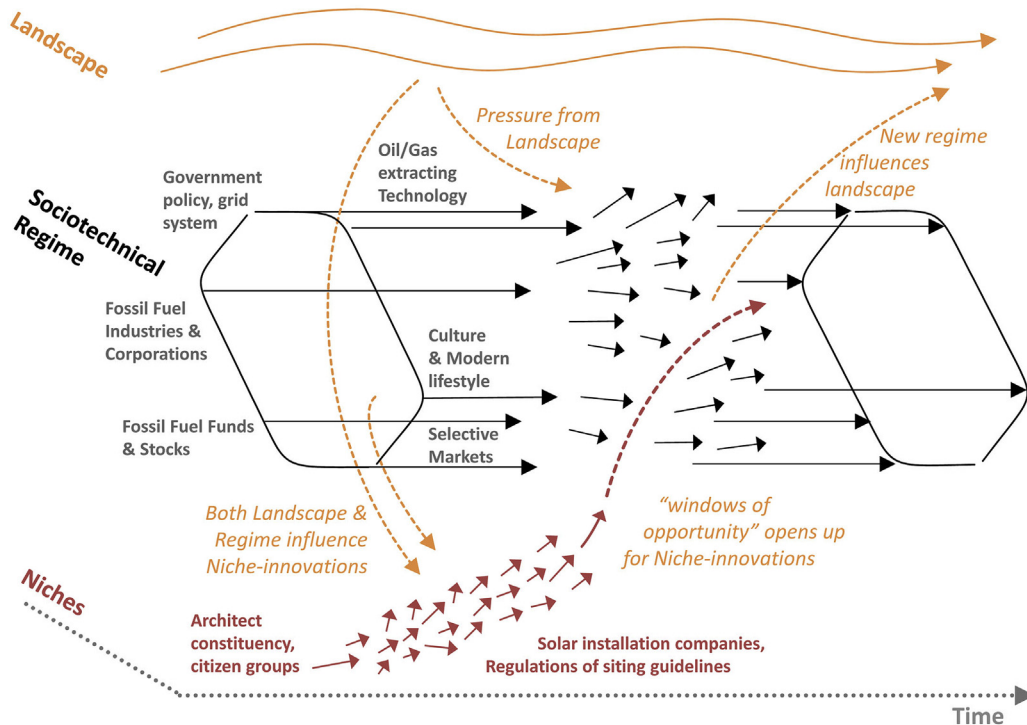


Figure 1 A multi-level perspective on renewable energy transition mapping the three levels of co-evolutionary activities with interconnected elements lying in the systems and the niches projection, adapted from Geels and Schot (2007, p. 401)

visions or other strategic scenario actions that are typically either detached from present-day concerns or require daunting resourcing to succeed. The case we discuss in this paper is an anticipatory conceptual design to target foreseeable reverse salients in system transition – a strategically focused effort, yet with a relatively modest scope. The case in point relates to permitting and promoting roof mounted solar installations for existing housing stock. Finland has already experienced severe curbing of wind power installations due to resistance to the landscape effects (Korjonen-Kuusipuro & Janhunen, 2015). It is foreseeable that some city planners, conservation architects and citizen groups will begin to question the visual suitability of solar installations on housing stock. It is equally foreseeable that the (predominantly small) installation companies are only likely to pay attention to the visual qualities of solar installations once they face resistance and, in their after-the-fact response, fuel calls to curb the aesthetic brutalization of the housing stock. If the course of events is allowed to run unaided it is likely to set a reverse salient to solar installations in urban areas. Henceforth the foreseeable reverse salients suggest that sustainable design efforts target exploring how solar installations could fit the existing housing stock and provide exemplars of how such installations could be pursued without unduly disturbing the architectural qualities of existing buildings. The lessons learnt could be of equal importance for overcoming

categorical resistance to solar installations as well as for installers gaining insight regarding the ways one can consider the aesthetic and cultural heritage value of solar installations. The currently existing guidelines for siting solar on heritage buildings presume one should simply refrain from doing so and, if anything, hide them from view (e.g. [City of Ballarat, n.d.](#)). Whilst a good precautionary principle, there are already examples of how solar can be installed successfully without damage to the historic milieu, the Vatican being a prime example. Moreover, the siting guidelines and the visual understanding for what adequate solar siting may mean are in a rather different order of detail, as we demonstrate below.

The setting where we chose to engage with the issue resulted from a contingent opportunity, whereas the design methodology chosen for the task was deliberate. The setting for exploring alternative ways to deploy solar technology in the existing housing stock was an architecturally significant building, ‘Dipoli’, designed by Reima and Raili Pietilä in the 1960s on the campus of Aalto University. The building is currently undergoing extensive renovation and a change in purpose, as well as being tied to Aalto University’s campus reform, aiming to achieve energy self-sufficiency by 2030. The Dipoli building is clearly not amenable for the bulk installation of solar arrays and hence is well suited for exploring the possibilities and limitations of siting solar in the existing housing stock.

## *2 Value Sensitive Design as an approach for strategic visualization*

In a case like this, design can provide a proactive concept and visualization of the alternatives in the presence of the multiple competing values that need to be taken into consideration. To do so, we turned to the Value Sensitive Design (VSD) framework ([Friedman, Kahn, & Borning, 2013](#)).

VSD is a framework for considering values with ethical import in design work, that is to say, values beyond instrumental good or economic value ([Friedman et al., 2013](#)), including values such as environmental sustainability. VSD consists of three types of investigations: conceptual, empirical and technical, and is characterized by its iterative and integrative manner throughout its tripartite course ([Friedman et al., 2013](#)) ([Figure 2](#)). Conceptual investigations initiate value consideration including *explicitly supported values* and *inherent stakeholder values*. The investigations help reveal the value tensions and trade-offs of the stakeholders in addition to their interests. Empirical investigations concern contextual exploration, observing and measuring activities in which stakeholders interact with the technology and formulation of the prior investigated values into criteria guiding technology design. Technical investigations examine and analyse properties of the technology and use statistics in order to inform alternative concepts. As a result, the final technology design could be

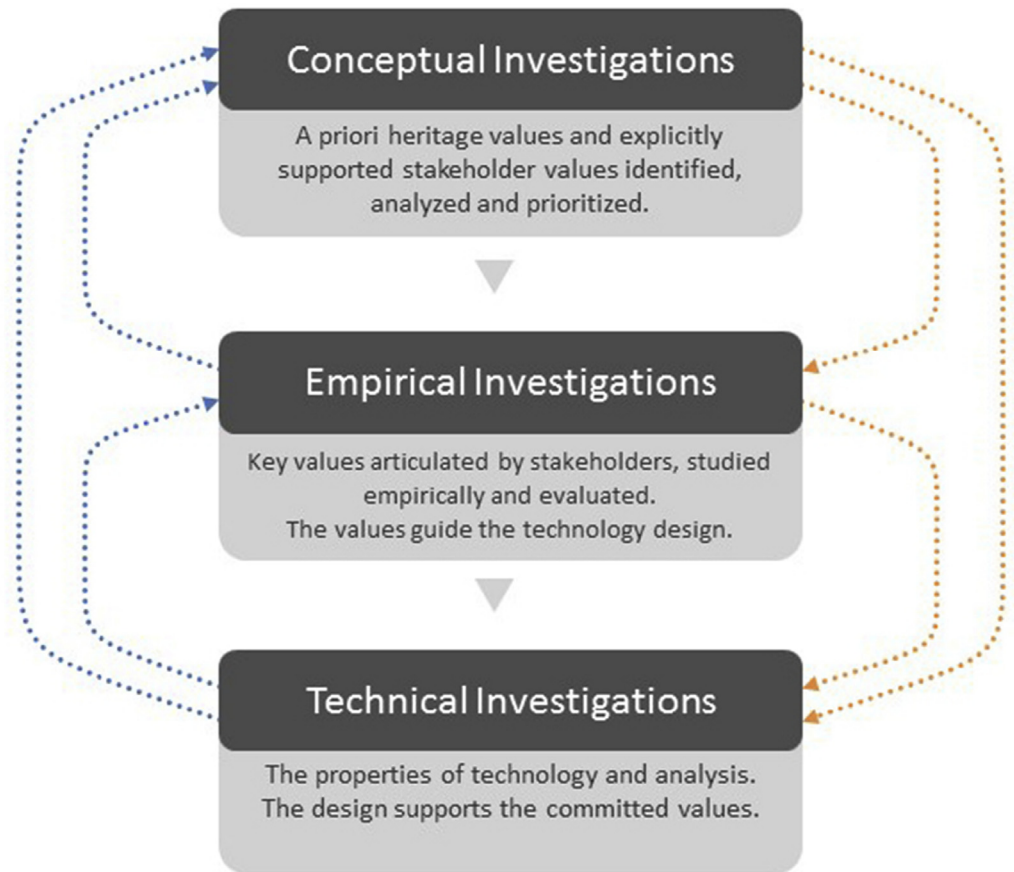


Figure 2 The VSD framework and process used in the present study

used to support the values identified and elaborate further for stakeholders the long-term consequences of alternative technical choices (Borning, Friedman, Davis, & Lin, 2005). Adopting a flexible investigation arrangement (Borning & Muller, 2012; Dantec, Poole, & Wyche, 2009), we integrated value considerations iteratively with empirical investigations, followed by using technical investigations to realize the design. Methods applied included interviews, field observations, a literature search and document analysis on the history and heritage value of the site, a technical search and the calculation of different yield options; as well as stakeholder mapping, and value deliberation and prioritization (Friedman et al., 2013).

### 3 The VSD process applied to Dipoli's renovation

#### 3.1 Conceptual investigations

In investigating the potential to site solar technology on Dipoli as part of its renovation, several key values became evident. The first clear key value was

*cultural heritage preservation*, as the building was a 1960s landmark by a renowned Finnish architect. The second, *campus prestige and image*, was an evident and strong value in the renovation of Dipoli as it was decided that the University Presidency, the Faculty Club and various visitor events would move to the building. The third, *ecological modernization* (Mol & Sonnenfeld, 2000; Murphy & Gouldson, 2000), was on the agenda of campus development, backed by the campus vision of ‘energy self-sufficiency by 2030’, which indicated that ground source heat and solar would be the prime sources to be used but that the total campus roof area with a sufficiently high yield would not be nearly enough to cover the power and heat needed by solar. Many of the rooftops were those of protected buildings, highlighting the need to consider if these too could be used (Internal Report: Campus vision 2030). Finally, an equally important key issue was the *economic costs and space viability* regarding the renovation, including whatever renewable energy it would include.

The conceptual inquiries revealed that these key values could potentially conflict with one another irresolvably, an issue VSD is particularly sensitized to (Friedman et al., 2013). Interpreting cultural heritage preservation as restorative practice would effectively preclude any modernization of the building and its uses and prevent any solar technology additions. Campus prestige might require new uses and access for the roof areas, making solar installation difficult and potentially harming cultural values. Economic viability might, in turn, suggest only a token adoption of solar on the premises. Finally, maximizing the amount and yield of solar panels in the name of ecological modernization would result in a loss of aesthetic and cultural heritage values – ‘ecological brutalization’ as we came to call it.

These potential conflicts were further aggravated through being primarily promoted by different interest groups. By adopting quadrant stakeholder mapping as an analytical tool, we projected the concerned stakeholders on the map according to their power and the extent of their interest. They include *direct and indirect stakeholders* and their *key and corresponding values* (Friedman et al., 2013). Analysing value comparison and prioritization between groups, the map visualises the conceptions of different stakeholders when siting solar technology on Dipoli. Finally, we identified the key stakeholders as: Aalto University Presidency, Aalto University Properties, the solar technology providers, the architect constituency (which includes some architects in the renovation project and the National Board of Antiquities). The interested but less powerful actors were primarily students and alumni of Aalto University.

In VSD, the value prioritization process is an intermediate step in further distilling investigated values, in this case suggesting that a value mix and working compromise would be needed for an acceptable solution regarding

inherent stakeholder values (cf. [Friedman et al., 2013](#)). Here, greatest priority was given to *the preservation, renovation, and modernization of heritage*. Subsequently the *aesthetic quality* was a desired concern, and *functionality, the cost-and energy-efficiency of the building* were of pragmatic importance. Last but not least, the establishment of *the identity of the university* being an environmentally conscious and prestigious educational institution. The power of the VSD framework resides, however, in connecting the a priori value with empirical investigations into how the particular values have been and could be realized through design. We now turn to the empirical investigations.

### 3.2 Empirical investigations: a historical enquiry into heritage value

The concepts of *preservation, modernization and aesthetics* required deeper investigation into architectural heritage. To assess their significance, we focused on the *evolutionary changes* of Dipoli by conducting architectural review and expert interviews with architects and a heritage researcher.

Dipoli, designed by the Finnish architects Reima and Raili Pietilä (1923–1993, 1926, respectively), was the design with the highest vote from students in a competition ([Johansson, Paatero, & Tuomi, 2009](#)). The building was inaugurated in 1965 and was later converted from a locality of students to a commercial congress centre due to financial difficulties in the 1980s ([Aalto University, 2014](#); [Quantrill, 1985](#)). The table below ([Table 1](#)) chronicles the architectural conversions during the past fifty years (also see [Figure 3](#)).

Considering the *architectural value*, Dipoli was envisioned as a many-sided architectural experiment. Amongst the most important aspects of Dipoli was it being an *environmental experiment* in exploring the interaction between the building and the environment ([Hansen, 1967](#); [Kultermann, 1967](#); [Norberg-Schultz, 1967](#); [Pietilä & Paatelainen, 1967](#)). The experiment engaged a natural extension of the landscape ([A+U, 1974](#)) with Dipoli deliberately hidden in the pine forest ([Johansson et al., 2009](#)) ([Figure 4](#)).

The contradictory exterior contested geometry and freeform features that highlighted Dipoli's *dual-character* at the same time made it notorious for being *imbalanced*. Pietilä explained his rational intention of providing both functional and expressive aspects ([A+U, 1974](#); [Johansson et al., 2009](#)). Despite the roofscape being criticized for *losing control*, the critically acclaimed architect reasoned that his concept mimicked the underlying contour of rock and a *dinosaur's silhouette* ([Quantrill, 1985](#)) ([Figure 5](#)). Pietilä's design expresses both Finnish localness and international modernism ([Johansson et al., 2009](#)). As stated in a review, *'to Pietilä, being "modern appropriately" is important'* ([Quantrill, 1985](#)).



**Table 1 A history of Dipoli referring to its conversions in function and design alterations**

<i>Year</i>	<i>Functional conversions</i>	<i>Design alterations</i>
1961	Architectural competition	/
1962	Wins the highest vote of students from joint first place result	/
1961–1965	Construction	/
1966–1981	Built with students' funds and owned by the Student Union of the Helsinki University of Technology; symbolic of the 'Second Poly' for student activities and conferences for financials	Minor alterations due to maintenance; students' ideas lead some functional changes
1981	Becomes an international conference centre; no student activities are located in Dipoli. Student ownership remains but student union office moves out	The main commerce-related changes included changes to the wall colour, flooring materials, staircase and window blockages; some spaces are retrained from student use
1986	/	Rooftop renovation for maintenance
1993	Turns into a congress and training centre due to a reduced number of international conferences in the 1990s' depression	Commerce-related changes continue, changing surrounding context
2010	The ownership shifts from the Student Union to Aalto University when three universities merge	Commerce-related changes continue, changes in surrounding context continue
2014	Bought by Aalto University Properties. Renovation Plan 2015–16	
2015	Renovation Plan 2015–16 for the National Board of Antiquities	

Sources: Johansson, Paatero & Tuomi, 2009; Arkkitehtitoimisto ALA & Vesikansa (Building History Report of Dipoli), 2015.

This architectural history is key to understanding the nature of Dipoli's heritage value, and an important backdrop for the perceptions that the heritage constituency holds about the building. In our interviews, a key legacy holder of Pietilä architecture stressed the importance of the roof, whilst recognizing that modernization could take place if done properly:

The roof of the Dipoli is a very important element of the building ... of course there are areas of the roof on which you could not place a [solar panel] installation without them ruining the silhouette ... It is all right as long it does not ruin the valuable building's architectural appearance – the very reason that building is a heritage building (Interview with a key Pietilä-architecture legacy holder, 16 November 2014)

However, a professor of architecture developing the campus dismissed the idea from the outset:

'I'm afraid that the thought of installing solar panels on Dipoli is a dead-end thought because of the architectural value of the building ... Otaniemi

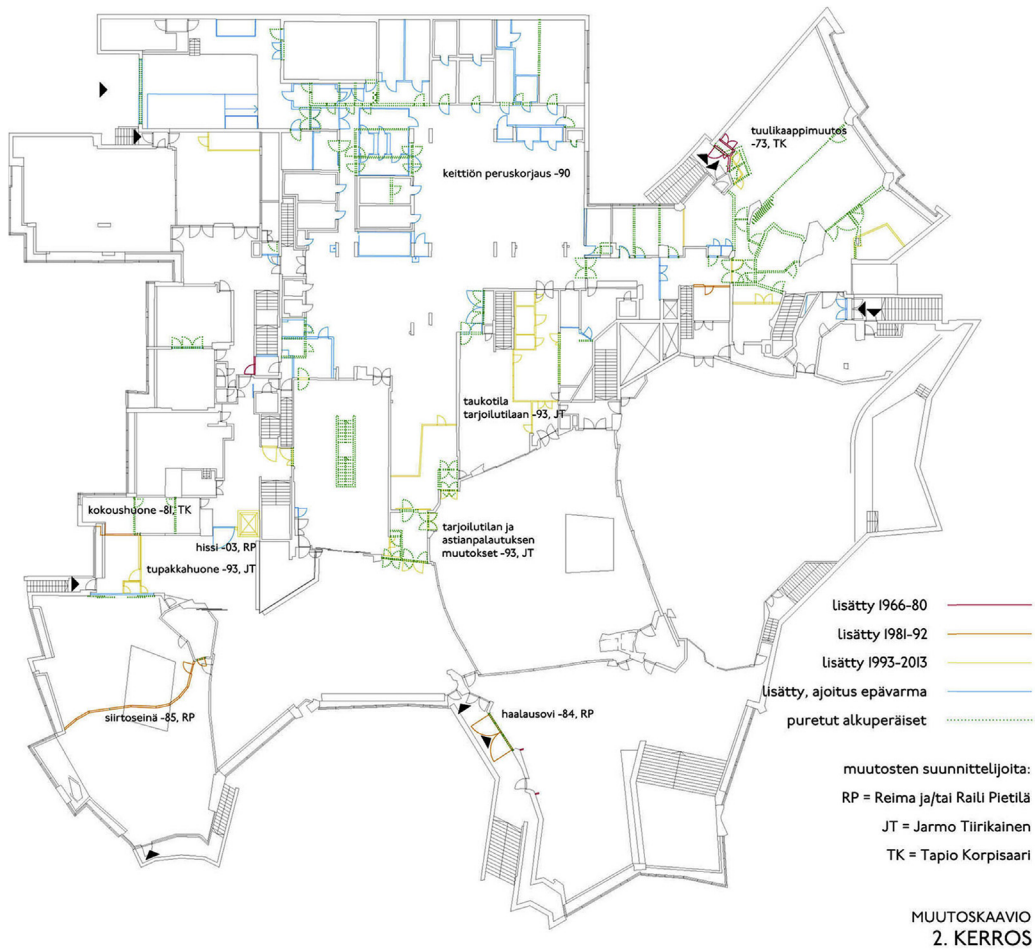


Figure 3 A plan view shows the modifications to Dipoli that have been carried out since 1966 (Arkkititeitöimistö ALA & Vesikansa, 2015)

is full of anonymous, mediocre brick buildings. There would be no harm in covering them with solar panels ... This sounds fun and dangerous simultaneously. Hopefully she really has a permit to enter the fragile copper roof and insurance!' (Email correspondence with a professor of architecture, 15 November 2014)

Similarly, the architect commissioned for making a heritage preservation study preferred that the building would not only be restored to its original state but to the envisioned state of full copper roofing to which the professor in the above quote points. These views articulate one legitimate operationalization of the architectural value of Dipoli but not the only possible one. In fact, they essentialize the drawn character of Dipoli, contrasting it with the myriad changes that have taken place owing to construction techniques and alterations done at the time of building and since. Dipoli was envisioned to



*Figure 4 An aerial view of Dipoli (centre, left). Photo by Martti I Jaartinen, 1966/1967 (from the archives of the Museum of Finnish Architecture, The MFA, 1967)*

stand on a natural rock form but, as this did not work out, cut rocks from the building site were piled on its sides. As a designed-in feature, the copper stripes on the building sides have weathered and changed the image of the building. The image of the building has been changed also by the gradual and dramatic diminishing of the pine forest around the building. It has been replaced by birches, bushes, an extended car park and some twenty tall flagpoles with colourful university flags erected outside the building. Similarly, the roof was never too fragile to walk on. From the outset only part of the roof was covered by copper folio and then, in the late 1980s when bitumen felt technology evolved, the entire roof area was covered with this more reliable roofing material, granting unhindered access to the roof. [Table 2](#) shows a chronicle of Dipoli's rooftop (see [Figures 6 and 7](#)).

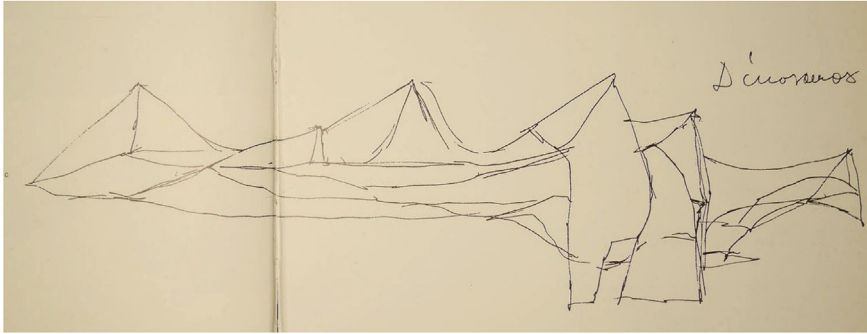


Figure 5 The dinosaur's silhouette by Pietilä (Quantrill, 1985)

**Table 2 A history of Dipoli's rooftop referring to its preservation values**

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*Condition & reasons of alteration*

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1965:

- All flat surfaces in bitumen felt are topped with gravel for waterproofness and cost-effectiveness. Note: Agreed with by Pietilä.
- All non-flat surfaces (the slope band, skylight boxes and small ventilation boxes) are covered in copper folio due to the technological limitation that bitumen felt cannot cover slopes (at this time).

1986:

- Renovation for maintenance.
- All surfaces are replaced by new bitumen felt, including slopes (due to a technological advance).

2015 (another 20 year gap):

- The Dipoli Renovation Plan is to be carried out, starting summer 2015.
- 

Source: [Arkkitehtitoimisto ALA & Vesikansa, 2015.](#)



Figure 6 Martti I. Jaatinen, 1967 (archives of the Museum of Finnish Architecture, *The MFA, 1967*)

Figure 7 Dipoli's whole rooftop was covered with bitumen felt on 13 November 2014



Clearly the preservation constituency is correct in thinking that an efficiency-maximizing straight-line array of solar PV would do nothing but ruin the architectural value of the building and should be categorically ruled out. Yet there may be solutions that would fit the evolving nature of Dipoli as a contextual experiment — after all, architecturally successful solar additions have been achieved on buildings such as the White House and on the rooftops of the Vatican, and indeed, Dipoli was planned from the onset for evolution over time with its surrounding environment.

### *3.3 Empirical investigations: field observations and interviews on solar energy siting*

Field experiments for real-life evaluations are one cornerstone of VSD. We started with field observations and next trialed real PV panels, placing them on the rooftop to test alternative scenarios on-site.

Different visualization investigations for future projections are under study for transition management or decision making in urban planning for change in the desired direction (van Dijk, 2011; Myers & Kitsue, 2000; Schot & Geels, 2008). There is also design visualization contributing to sustainable transition research through generating scenarios to actively represent future vision that would entail present day transformations (Gaziulusoy & Ryan, 2015). This type of future visioning is being explored and emerging in transition studies. In our case, as discussed in sections 1 and 2, the aim of visualization was to provide anticipatory investigation regarding likely reverse salients. In the empirical investigation, we decided to ground views about the PV panel siting in a real life context, putting real PV panels on Dipoli's rooftop and conducting on-site interviews to elicit views about them and gain a sense of how people regarded actual and not some hypothetical presence of a solar array.

Fifteen visitors were interviewed at the entrance and five inside the cafeteria on the second floor (where the two ends of the rooftop are still visible). Most of the interviewees were with engineering and architectural students (Figure 8).

The respondents expressed a general consensus on the *environmental importance* of including PV with the building. The interviewees remarked that the prototyped PV visibility did not disturb the heritage but could also be used as an eco-conscious university identity. Some also described Dipoli as a modern building, highlighting how people perceive *modern*: it is not limited to an architecturally modern style but in fact expects modern buildings to retain contemporaneity. Although renewable energy technology was positively viewed, around one-third of the interviewees expressed an *aesthetic* concern that the installation would need to be done properly and with care.

Further, the stakeholders' conceptions could be formulated as criteria to guide the technology design: (1) preservation yet modernization, with consideration of the impact of aesthetics, taking the notion from stakeholders' articulation of visibility and modernity, (2) the identity that Aalto University is establishing through practices of being eco-conscious, and finally (3) environmental importance of producing renewable energy without greenwashing and ecological brutalization.

VSD was thus helpful in iteratively moving through the steps of the a priori values committed to heritage preservation, the empirical findings of historical evolution and opinions established by professionals, and the further articulation of stakeholder values from on-site observations. We now move on to the technical investigations for the design.

### 3.4 Technical investigations

Guided by the formulated criteria, design concepts were generated after studying the properties and technical data of solar technology. To summarize, from the internal Report of Energy Self-Sufficient Otaniemi (Aalto University Properties, 2014), the total of Otaniemi Campus's solar energy production (16.4 GWh/year) is set as a target for Dipoli's energy production; the solar irradiance map of the campus indicated 1000–1200 kWh/m<sup>2</sup>/year as the optimum solar radiation area (Figure 9) and the total rooftop area of 5554 m<sup>2</sup>. The Photovoltaic Geographic Information System (European Commission Institute for Energy and Transport, n.d.) recommended 35–45° as the optimum panel-tilt angle for the best possible capacity in Helsinki and provided simulated energy figures. Also, the breakdown energy consumption of Dipoli during 2009–2014 from Aalto University Properties indicates that a mix of solar PV and solar heat collectors would be preferred. The PV costs per watt, the infrastructure set-up and maintenance costs from the Finnish solar panel producer established the long-term economic viability.



Figure 8 The prototyping experiment view of solar panels placed on the rooftop at 45° angles and left 'subtly' visible

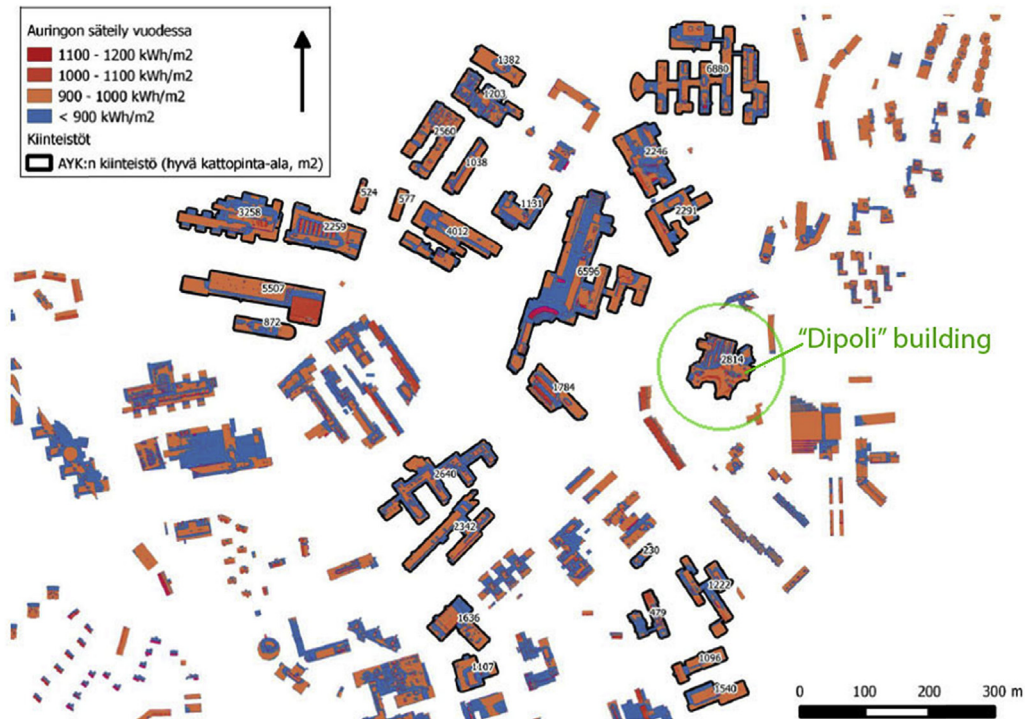
In the last round, taking the minimum energy yield, conversion loss from DC to AC and the respective combination of solar panel and collector, we provided the optimum solar design choice concerning the amount, position, direction, angle and arrangement of panels. In the end, a total of 277 pieces of PV panel installation were suggested for the total energy production of 160 326 kWh/year, covering 557 m<sup>2</sup> out of the 5554 m<sup>2</sup> rooftop area. To break this down, 216 solar panels covering 432 m<sup>2</sup> and yielding 64 800 kWh, and 61 solar collectors covering 122 m<sup>2</sup> and yielding 95 526 kWh for heating.

Due to the decreasing price of solar panel units a 15-degree angle could viably be used (instead of the optimal 45-degree angle) as this would diminish yield by only 10–15% due to the possibility of closer positioning of the PV racks. This flatter assembly clearly offered a more suitable alternative with respect to the aesthetics of the Dipoli roof areas.

#### 4 Results and the resulting design concept

The outcomes of the conceptual, empirical and technical investigations suggested either a fully invisible installation or an installation that would only be modestly discernible from a few ground locations (i.e. being practically invisible yet detectable). This concept of *subtle visibility* was found to be the most promising in supporting the specific values identified. The design concept suggests an equilibrium between preserving the valuable roofscape yielding meaningful energy production without greenwashing. The modernization through introducing sustainable renewable energy also maintains the long-term heritage use and associated preservation significance but corresponds to the university's eco-conscious identity. This 'evolutionary modernization' implicitly practises Pietilä's principle of a contextual relationship with social and cultural development. The diagram below illustrates the integrative and iterative process of the VSD tripartite course under study (Figure 10).

Building on the on-site prototyping, a further visualization, gained through architectural rendering, was generated (Figures 11–15) for Aalto University



Kuva 8. Aurinkoenergian tuotantoon parhaiten soveltuvat kattopinta-alat AYK:n kiinteistöissä Otaniemessä.

Figure 9 A solar irradiance map of Otaniemi Campus, Aalto University (Report 2014, p. 22)

Properties as a model for further expansion of the project or other solar energy siting on the campus.

The study did not aim at a final design solution but the images projecting the VSD brings the visions to the forefront of the renewable energy transition process, which are feasibly available as a project guideline for scaling up to other similar sustainable renewable energy investigations in Finland.

## 5 Conclusion

This paper has described a design project to further renewable energy in Finland. We have sought to illustrate how, on the one hand, sustainability transition may require different criteria and orientation for strategic design than has previously been used (strategic design used to orient companies beyond their current markets, production and delivery processes or used to orient industry consortia in their fields) (Keinonen & Jääskö, 2004; Keinonen & Takala, 2010). While traditional kinds of strategic design have their place within sustainable design, sustainability transitions also surface the potential for new types of strategic design where the net benefactor, and hence the entity defining the strategic aims and making strategic decisions, is



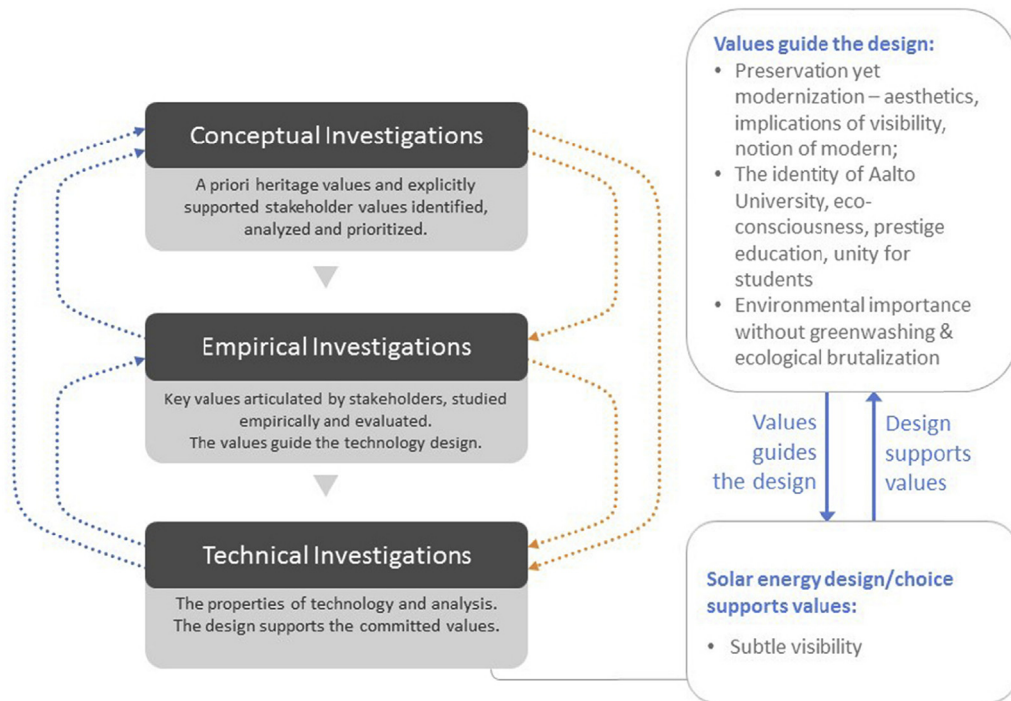


Figure 10 The VSD technical design supports the investigated values

not any one self-interested entity but rather the common environmental and social good. In such contexts the role of strategic design and strategic visualizations are easily limited to portrayals of high-level visions or anticipatory design concepts. In this paper we have illustrated how strategic visualization can also be pursued through very concrete and operational concept design visualization. Such visualization is not strategic because it is abstracted to a ‘strategic level’ or a mid range to long-range projected timeframe – in other words, removed from the operational concerns of the present day – but is strategic because it targets the reverse salients (Hughes, 1983) that will foreseeably form in the near future – in this case the need to install solar technology across the existing building stock, which can lead to detrimental side effects and the ensuing resistance from different stakeholder groups if handled poorly.

In such anticipatory governance of advancing systems transition (Verbong & Loorbach, 2012), design approaches (such as VSD) can help clarify the concerns and offer alternative solutions for deliberation among stakeholders (who may from the outset have diametrically opposed interests). The illustrations pursued here regarding Dipoli were taken to a level of concreteness that allows anchored discussion of the pros and cons of the solution and hopefully its further elaboration by different stakeholders. The project documentation provides help for clarifying the rationale and considerations behind the

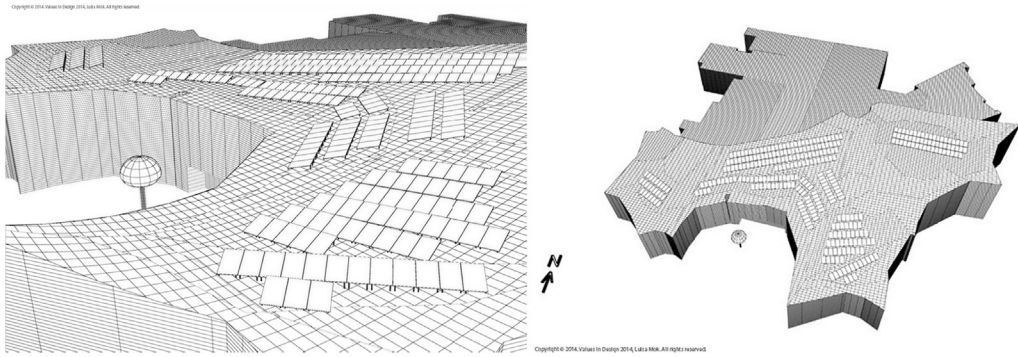


Figure 11 A realistic architectural rendering for visualization and documentation as demonstration projects



Figure 12 The solar array on the rooftop



Figure 13 The solar array visible from the rooftop, viewed from another angle



Figure 14 A bird's-eye view of Dipoli with the solar array



Figure 15 The view from 100 m away, the only distance from which the solar array is visible at ground level

solutions, and if it leads to further development and implementation it offers a possibility to have a demonstration site with documented guidance as to why and how the solutions ended up the way they did, amidst the legitimate value concerns pertaining to the project. In sum, then, we are not suggesting that we have aimed at or produced the optimal way to site solar on a heritage building, let alone suggesting that VSD should be pursued whenever the ecological modernization of a heritage building is pursued. What we do suggest is that:

- a) sustainable design initiatives should consider how they link to broader sustainability transitions and choose their modes of engagement accordingly, to improve their relevance and potential for change;
- b) the visualizations and documentation of successful demonstration projects can provide concreteness for guidelines and statutes – in this case to guidelines pertaining to the siting of solar on heritage buildings (these are currently written from a categorical ‘solar is always an aesthetic violation of heritage value’ perspective, which does not hold true);

- c) frameworks such as VSD can be a useful addition to the toolbox of sustainability transitions.

What these suggestions amount to are steps towards an alternative perspective for a new design approach to deal with sustainability transitions.

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