FASTLANE – Dynamic approach to low carbon and energy producing real estate portfolios – case Amsterdam Universities

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Abstract. In The Netherlands Municipalities, Universities and Healthcare organizations all have targeted to meet the Paris agreement targets, 'Nett Zero Carbon' namely 95% CO_2-emission reductions compared to 1990, long before 2050. To support these organizations on their journey to meet their targets effective and efficient, regarding Carbon emissions as well as costs, a dynamic approach called FastLane is developed. FastLane has already been used for more than 1,000 buildings in more than 75 portfolio roadmap plans to reduce in total 1-3 Mton CO2 emissions by 2050. Implementing all these plans, we can reduce up to 1-3 Mton CO_2 by 2050. This approach deals with three important challenges of the energy transition: only limited time and budget available, close the energy gap between calculated and measured Carbon emissions and provide a dynamic insightful tool to monitor and control the energy transition. These challenges require a different approach than traditional energy studies to identify and select measures. In this paper the requirements, demands and benefits of the developed approach, consisting of a methodology, smart tools using databases and strong insightful presentations in dashboards, are explained.

The approach is illustrated with the case of University of Amsterdam & Amsterdam University of Applied Sciences with a combined portfolio of 50 buildings. Insights are given how Amsterdam University aims to reach their targets and how they are in control doing so during their journey. A roadmap with the most important renovation measures is presented including the possibilities of dynamic interventions adapting to possible changes in the future. Enabling an optimized timing of applying the measures. This already saved Amsterdam University up to 20% of the costs for the energy transition and optimizing the implementation along the way will guarantee the most effective and efficient energy transition of the real estate portfolio.

Keywords. FastLane approach, Energy, Carbon emissions, Roadmap, University Buildings, Real Estate Portfolio.
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1. Introduction

In The Netherlands Municipalities, Universities and Healthcare organizations have targeted to meet the Paris climate agreement targets (Conference of Parties November 2015), 'Nett Zero Carbon' namely 95% CO_2-emission reductions compared to 1990, long before 2050. To meet these energy transition targets millions of buildings need to be made more sustainable over the next thirty years. This requires thoughtful planning to accelerate the right decisions and effective implementation.

To enable organizations to realize the energy transition with their building portfolio in time there are three important challenges on strategical, tactical as well as operational level.

The first one is about making roadmaps, long term plans for a period of 30 years, for not one but a portfolio of buildings. Since there is no time to waste this must be done in a short period of time to set the target and reserve the required investment budget. Traditional approaches use energy studies for every single building and use different software tools to calculate the energy performance and cost, taking the maintenance plans into account. To develop the roadmap a new approach is required because the traditional approach is to slow, time consuming, with too much detail and unnecessary expensive.

The second one is the energy gap between calculated and measured energy use and consequently the gap between calculated and measured CO_2-emissions. Evidence on the magnitude of the gap is adding up fast, suggesting buildings tend to use 1.5 to 2.5 times more energy than predicted in their design [4] [5]. Traditional approaches use mainly calculations to make predictions without fitting the predictions to the actual energy use and CO_2-emissions. However, in the end we need to reduce the actual measured energy use and CO_2-emission. Therefore, the required approach should explicitly focus on these actual reductions instead of calculated theoretical energy and CO_2-emission reductions [6].

The third challenge is the dynamic character of the energy transition with an increasing number of technological innovations and legislation changing rapidly. To manage the energy transition, monitoring compliance and the realised increasing energy performance, of each building and the portfolio of buildings as a whole, is required.

2. FastLane approach

The FastLane approach is a development of Royal HaskoningDHV and is designed to deal with the challenges mentioned above. It focusses on the energy saving measures to be taken at building and portfolio level with starting point the usage of the building and the possibilities and energy infrastructure in the vicinity of each building. The approach consists out of 5 steps, see Figure 1.

Fig. 1 – Visualisation of the 5 steps in the FastLane approach [1].

Deskresearch - The first step is to collect and validate the existing data very thoroughly. In most cases a lot of data is already available. The data is checked on validity and added when required with some assumptions based on benchmark data in a database.

Inspection - Next in step two on-site inspections are performed to validate data and assumptions and, in the meantime, already check practical feasibility of intended measures. The data aggregated with on-site visits including photo's is archived and is already valuable for building owners.

Expert session - In step three, the collected data, information and proposals are discussed with your organization during an expert session, integrally per building, and assessed by a team of experts (energy transition scout, energy expert, structural engineer, cost expert). The aim of this session is to identify the possibilities and impossibilities together with the property managers and building managers to select the most promising measures.

Calculation - Based on these results, in step four, the energy expert and cost expert calculate CO_2-emission reduction, the investments and savings of each measure. With the software module the calculated measures from the library are fitted to the actual energy use of the building. Then the measures of a selected scenario with a package of measures is plotted. The measures can be planned in line with the Multi-Year Maintenance Plan.

Scenario's - In step five the scenarios with packages of measures are selected for each building and the portfolio of buildings. Afterwards it will still be possible to make changes in the digital platform to optimize the scenario's and/or update the baseline to the actual situation. The digital platform offers a set of dashboards to optimize the planned measures and to monitor the calculated and realised performance, see Figure 2.

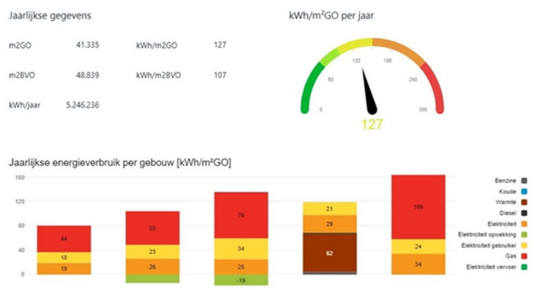

Fig. 2 – Visualisation of dashboard and a dynamic monitoring and control on tablet [1].

3. Case study – Amsterdam Universities

The Dutch universities have committed themselves to the Climate Agreement by means of the sectoral roadmap. This roadmap indicates that the sector will contribute to achieving the climate objectives. By means of an institutional roadmap, the universities are expected to demonstrate their annual contribution. To draw up the institutional roadmap, an inventory and calculation is required of the possible and intended sustainability measures per building. Based on the components described below, we provide our vision and principles for creating a successful roadmap. The University of Amsterdam and the University of Applied Sciences in the city are taking the lead in the energy transition. They are preparing their entire building portfolio to meet the targets of the Paris Climate Agreement targets by 2040.

The two universities house around 100,000 students, teachers, and support staff in a real estate portfolio of 650,000 m² which includes centuries-old inner-city buildings and historic monuments, see Figure 3.

Fig. 3 – Impression of the different types of University Buildings within the four campuses [3]

The different building styles and functions vary too - from laboratories and lecture halls to offices and student accommodation. It makes the transition to low-carbon buildings complex and challenging.

4. Results

The FastLane approach provided an overview across the entire portfolio of more than 50 buildings. In Figure 4 the energy consumption for a selection of buildings is presented including the target energy consumption for 2050.

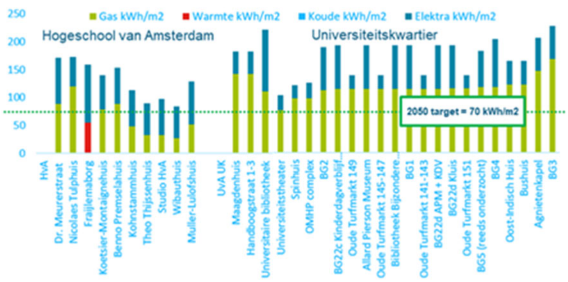

Fig. 4 – Baseline (2018) energy use of some buildings [1], [3].

After executing the first two steps of the FastLane process, a series of expert sessions with representatives from the university and partner organisations to discuss and identify appropriate measures and timings for implementation were held. Decisions were made at the level of individual buildings and the impact across the whole portfolio tracked. Through structured data collection, it was possible to adjust and optimize the plan when there were new insights.

The measures for a typically old and new building are presented in Figure 5 and Figure 6. Here we did calculate the CO_2 that should be reduced by the Paris Climate Agreement. To reach the remaining CO_2-emission reduction of 95%, the net supplier will need to make the electricity net more sustainable upcoming years.

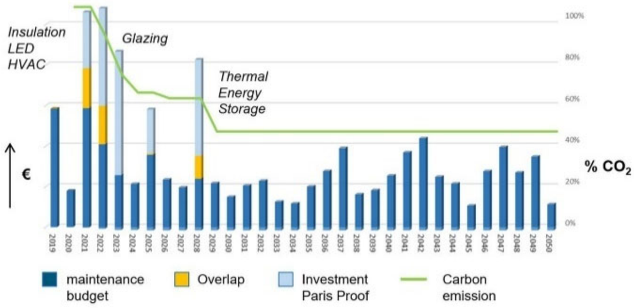

Fig. 5 – Yearly CO_2-emission reduction and required investments for a typical old building < 1800 [1], [3]. If we include indirect effects of net supplier, it will come close to 95% CO_2-emission reduction.

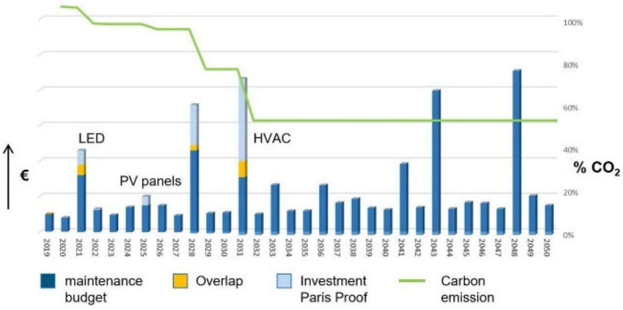

Fig. 6 – Yearly CO_2-emission reduction and required investments for a typical modern building > 2004 [1], [3]. If we include indirect effects of net supplier, it will come close to 95% CO_2-emission reduction.

An overview of the most effective energy saving measures is given in the Table 1. Here we see that especially the changing of energy source will bring a higher efficiency. This in combination with improving the insulation and windows in the façade, replacing the air handling Units and integrating LED lighting in the buildings.

Tab. 1 – Calculated results for different scenario's [3].

Measures	Reduction CO_2-emissions [ton/a]
Aquifer Thermal Energy Storage in combination with Heat Pump	950
New Air Handling Unit with Heat Recovery	350
New wooden frames with HR++ windows	300
Inside facade insulation	250
Replacement single glass windows with HR++ windows	125
Twincoil Heat Recovery in existing Air Handling Units	100
Replacement of TL by LED lighting	50

Typical and effective energy saving measures for older buildings are:

- Insulation of roof and facade
- Applying LED lighting including smart daylight and motion control
- Replacing and upgrading the Air Handling Units

For newer buildings applying LED lighting including daylight and motion controls and photovoltaic solar cells are effective measures.

All buildings will benefit from a newly developed Aquifer Thermal Energy System combined with heat pumps. Of course, the heating and cooling systems in the connected buildings need to be upgraded to low temperature heating and high temperature cooling.

The automatically generated result of all buildings together for the so-called scenario ''all electric'' is presented in Figure 7. The CO2 emission reduces every year until 2040. Here we did calculate the CO_2 that should be reduced by the Paris Proof agreement. The remaining CO_2 will be reduced by the net supplier of the electricity upcoming years.

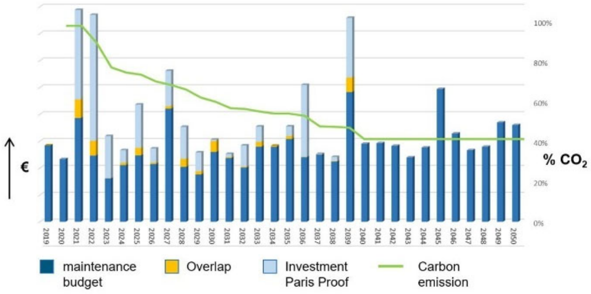

Fig. 7 – Yearly CO_2-emission reduction and required investments for building portfolio of campus 'Universiteitskwartier' [1], [3]. If we include indirect effects of net supplier, it will come close to 95% CO_2-emission reduction.

The results of the selected All electric scenario is presented next to 3 other scenario's that were evaluated in Table 2.

Tab. 2 – Calculated results for different scenarios.

Scenario	Reduction CO_2 emissions* [%]	Payback time [a]
Quick wins	5%	3
Business case	17%	25
All electric	37%	82
Max CO_2-reduction	44%	93

*The indirect effects of net supplier are excluded. If we include effects of net supplier, the All electric scenario will come close to 95% CO_2-emission reduction.

The University of Amsterdam and Amsterdam University of Applied Sciences developed their roadmap using the FastLane approach and now know the measures they need to take, the costs involved, have included them in their maintenance and investment plans and used this information in their energy roadmap report [2]. They are herewith one of the frontrunners in the Netherlands with a practical plan to realize energy transition targets for their building portfolio.

Additionally, by applying the FastLane approach they also completed 80% of the work to comply with Dutch energy legislation for the Energy Efficiency Audit (EED) and Information Requirement (EML) was completed.

5. Conclusions

- A new approach called FastLane, including a digital platform and database, is developed that enables building owners to plan, steer and monitor the energy transition of each building and the whole building portfolio.
- The resulting digital portfolio roadmap is fully secured in the building owner organization as an easily accessible, current, and living document with calculations fitted on the real energy usage and the flexibility to make changes and monitor the performance. Because all information is stored in a database it is easy to later make changes. In this way it is possible to make changes if this is needed for current and upcoming legislation.
- There is a big advantage of using real time energy in combination with energy performance. The effects of the measures can be checked with real-time energy meters. In this way it is possible to monitor the progress daily, monthly, and yearly. This is a great time saver compared to more theoretical approaches where for an update a new calculation is needed. In this way the first steps are made in the direction of energy management conform ISO 50001.
- Key in the approach is to gather and combine up-to-date information and knowledge: data in archives, data from on-site inspections, information of facility and maintenance managers and multidisciplinary expertise of consultants.
- Integration of measures in existing processes yields quality gains and savings. University buildings are being adapted continuously. Through DMJOP integration in these processes, higher savings can be realized in the realization costs.

- The Fastlane approach is successfully applied at the University of Amsterdam and Amsterdam University of Applied Sciences. It enabled this organization to:
    - update and archive data of the buildings, the use of the buildings and building services in a dynamic database that also allows automated analyses to select, plan and present the most effective CO_2-emission reduction measures. It provided a good overview and insight in the complex portfolio of buildings which was already very valuable;
    - develop and implement their dynamic energy transition roadmap, instantly calculating costs and the impact on energy use and CO_2-emissions;
    - Identify and select the measures that will realize the most CO_2-emission reduction each and in total together 1,850 ton: Aquifer Thermal Energy Storage in combination with Heat Pump; New Air Handling Unit with Heat Recovery; New wooden frames with HR++ windows; Inside façade insulation;
    - plan the implementation of different measures in line with natural moments of replacement and maintenance, which saved 20% in costs;
    - Organize and realize decision making by the board of the organization on ambition and budgets;
    - comply with legislation EU Energy Efficiency Audit (EED) and NL Information Requirement (EML).

6. Recommendations

The FastLane approach can be further improved and developed by expanding and keeping up to date of the database with benchmark energy data of different building functions and advised/applied measures.

Furthermore it is recommended to take notice of some lessons learned in the presented case and be prepared when applying the FastLane approach:

- Start with insulation and quickwins, the earlier you start the more CO_2 you can save;
- Trias energetica could be neglected if the aforementioned insulation measures are postponed and rising energy costs lead to faster sustainable energy generation;
- Plan the implementation of different measures in line with natural moments of replacement and maintenance. The number natural replacements until 2050 are scarce and may happen only once. The earlier you start, the more money, energy and CO_2-emissions you can save;
- Sustainable process knowledge and engineering is needed to turn a FastLane idea into an actual plan. This requires more from the operator than standard maintenance and additional expertise must be attracted for it. A balanced budget must also be abandoned within 1 year or the process must be arranged in such a way that in complex engineering assignments 20% of the preparation costs are released 1 or two years before the actual implementation;
- Collaborate with the building users to integrate their functional demands and achieve the highest perfomance of the energy saving measures;
- The approach consists of a tour of many complex buildings, but no detailed study of the BMS system. Some identified control measures were already implemented and others couldn't be implemented as stand-alone measures, but are part of a management contract with the major technical parties;
- Certain groups of measures have been found to be unprofitable after research or involve technical risks. Increasing room temperatures in MER/SER rooms resulted in the failure of UPSs and the application of an air scrubber requires much more than the indicators indicate;
- Implementation of insulation measures requires better real estate planning and are less suitable for inclusion in DMJOP because of the nuisance it entails. Many measures only have a natural moment during renovation and are postponed until then. Less is also possible according to monument care and well-being;
- Reserve enough time for preparation and execution and take some extra time into account for internal discussions on topics with more than one stakeholder and/or different opinions;
- Market developments must be translated

into budgets;

- Monitor the effect of measures and keep the digital dynamic roadmap up-to-date for maximum control on the energy transition of the building portofolio. Integrate this in your energy and building management system.

7. Acknowledgement

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Data Statement

The datasets generated during and/or analysed during the current study are not publicly available because of privacy of the client but could be made available in further consultation to the client.