9. SUMMARY

From the discussion above it is obvious that it is important to consider the building as an energy system when determining the retrofits done to the house. Choosing a boiler with low energy and low "power" costs makes almost all of the retrofits unprofitable. Systems with low energy costs and high power costs generate more envelope retrofits, and the systems with high energy costs and low power costs shall have an extensive energy retrofit done to the envelope. In Sweden today it is common to make both an extensive envelope retrofit and change the existing heating system to district heating. This thesis shows that this is absolutely wrong, at least if the district heating company is using the short range marginal cost pricing system.

Today it is also common to implement the retrofits in order of its profitability. This is in most cases wrong. Starting e g with caulking and some insulation retrofits makes the building consume less energy, but this also means that it is impossible to install a heat pump with any profitability. The wright strategy perhaps should have been to install the heat pump and skip all of the envelope retrofits.

It is shown that much more insulation shall be placed on the climate shield than is common today. The optimal thickness is mostly of the magnitude 0.2 m. Using e g 0.05 or 0.1 m extra insulation is worse than not insulating at all. This is so because the LCC becomes higher than without the insulation.

It is also important that the insulation measures are implemented at the same time that other things are done to e g the wall. Most insulation retrofits are only profitable if that is the case. It is also important to note that it is not profitable to reinsulate an already insulated wall. If the first insulation measure is not optimal, you have to wait until the facade has to be changed to get profitable retrofits.

The fact that the retrofits change the time constant in the

building has only a small influence to the strategy. However, the systems with high installation costs and low running costs, e g heat pumps, will get a better position if this is considered.

A mild climate, of course, makes it less profitable with an extensive envelope retrofit strategy.

The economical parameters are very important. Using a high discount rate makes almost all retrofits unprofitable. The same is valid if a short optimization period is used.

Complicated window constructions will almost never be profitable as an optimal strategy unless the windows have to be changed for other than energy conserving reasons. If that is the fact three-pane windows can be profitable. It is only the high energy cost systems that makes such windows profitable. The same can be said about the exhaust air heat pump retrofit. It is only if the energy, that is recirculated, is expensive that such equipment is profitable.

The cheapest retrofit, the caulking of windows and doors is almost always profitable. However, combined with an exhaust air heat pump sometimes makes it better not to caulk, because of the decrease in the ventilation flow.

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