UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Office of Sustainability
607 East Peabody, Room 163
Champaign, IL 61820

Memorandum of Understanding for Project Financing by the Student Sustainability Committee at the University of Illinois at Urbana-Champaign

Project: Plant Sciences Laboratory Greenhouses Shade Curtain Retrofit

Amount: $125,000

Originating Campus Unit: Office of Sustainability

Receiving Campus Unit: College of ACES

Funding Source: Student Sustainability Committee

Primary Contact Person: Ruth A. Green (Plant Care Facility Coordinator)

E-mail: rgreen6@illinois.edu **Phone:** 217-333-3058

Secondary Contact Person: Ralf Moller (Director of Operations)

E-mail: rmoller@illinois.edu **Phone:** 217-333-0242

Financial Officer Contact Information: Natalie Bush (Financial operations manager)

E-mail: ncb@illinois.edu **Phone:** 217-244-2842

Program Background:

The Student Sustainability Committee (SSC) is tasked with the allocation of the proceeds of two student environmental fees – the Clean Energy Technology Fee and the Sustainable Campus Environment Fee, to improve the sustainability of our campus. The committee has established a program to make funds available for efficiency projects that will be later returned for reinvestment in future projects.

Committee funds will be made available to the Office of Sustainability which will carry out an inter-departmental transfer to the Receiving campus unit. The Receiving unit agrees to return the transfer to the Office of Sustainability, in installments, as described on the next page, for reuse by the SSC.

Project Description:

The College of ACES Seeks funding for the installation of energy/shade curtains in the Plant Sciences Laboratory (PSL) Greenhouse. The goals of this project are to decrease the energy usage to heat and cool the greenhouse rooms, increase natural light quality in the greenhouse rooms, and decrease energy usage by the application and removal of whitewash. Additional project benefits are that the retrofitted greenhouse rooms will be of higher value for research and teaching purposes, by allowing increased use of higher-quality natural lighting, and enabling better lighting control.

Project costs includes the installation of energy shade curtains at the cost of ~$12,000 per room (for nine rooms), in addition to electrical work and new control systems and software. Total costs for the project are anticipated at $120,000, will be financed through this loan. In addition, the Committee will provide a grant of $5,000 for an associated sub-metering project to quantify project benefits.

Terms:

The Student Sustainability Committee is in favor of the Office of Sustainability transferring a loan of $120,000 and a grant of $5000 to the College of ACES for this work. The loan will fund the energy/shade curtain project and the grant will fund electricity and steam submetering for the green house section in which shade curtains are installed; through a student project. These funds are to be drawn from the Sustainable Campus Environment Fee account managed by the SSC, as needed to complete the project. All funds requested from the SSC must be expended before 30th October 2010, else the unit must apply for an extension.

.

The College of ACES agrees to return the funds provided by carrying out annual transfers to the Office of Sustainability due on the 15th of July of each year in the following manner:

$12,000 – Due 15th July 2012

$12,000 – Due 15th July 2013

$12,000 – Due 15th July 2014

$12,000 – Due 15th July 2015

$12,000 – Due 15th July 2016

$12,000—Due 15th July 2017

$12,000—Due 15th July 2018

$12,000—Due 15th July 2019

$12,000—Due 15th July 2020

$12,000—Due 15th July 2021

The Office of Sustainability will direct them back to the Committee's account. The College of ACES will provide a close-out report about the project after installation. The College of ACES will also appropriately publicize the Committee's support of this project.

This loan is made in the absence an existing campus decentralized energy billing program; the College of ACES commits to sourcing repayment funds from the Plant Care Facility Greenhouse Service Fee. If at any time the College of ACES becomes responsible for paying its own energy costs and accrues savings from this project, yearly repayments will increase to $20,000 for the outstanding amount of the loan.

All funds provided by this transfer will be used in a manner consistent with University of Illinois policies and procedures.

College of ACES

Ruth A. Green, Plant Care Facilities Coordinator
College of ACES

Date Approved: 6/09/10

Ralf Moller, Director of Operations
College of ACES

Date Approved: 06/11/10

Jozef Kokini, Associate Dean for Research
College of ACES

Date Approved: 6/21/10

Robert Hauser, Dean
College of ACES

Date Approved: 6/22/10

Student Sustainability Committee:

Suhail Barot, 09-10 Committee Chair

Date Approved: 6/3/10

Erin Harper, 09-10 Committee Vice-Chair

Date Approved: 06/07/10

student sustainability committee
university of illinois at urbana-champaign

Office of Sustainability:

Richard Warner, Director, Office of Sustainability

Date Approved: 6-4-10

Steve Sonka, Vice-Chancellor for Public Engagement

Date Approved: 6/29/10

student sustainability committee
university of illinois at urbana-champaign

To: Suhail Barot, Student Sustainability Committee Chair
Student Sustainability Committee
From: Ruth Green, Plant Care Facility Coordinator, Office of Research, College of ACES
Ralf Moller, Director of Operations, College of ACES
Date: November 23, 2009
Re: Letter of Inquiry

The Plant Care Facility (PCF) in the Office of Research within the College of ACES would like to apply for an interest-free loan to install energy/shade curtains with seals in the Plant Sciences Laboratory (PSL) Greenhouse. These curtains would
1) reduce our use of steam energy provided by Abbott Power Plant in the winter;
2) reduce the use of electricity by our heat exchanger, circulation pumps, and hot water valves;
3) decrease the electrical load on our supply and exhaust fans; and,
4) eliminate the energy used to apply whitewash in May and whitewash remover in October, in addition to the cost of materials, labor and water to do these applications.

Thus far, the College of ACES has installed energy/shade curtains in 18 of the total 64 greenhouse rooms in the PSL Greenhouse. We have 46 rooms left that need curtains. The cost per room (10 feet by 20 feet) started at $5-6,000 in 2004. Now, the cost is, approximately, $10-12,500, depending upon the room size. The largest room is 25 feet by 50 feet. The faster we can install these energy/shade curtains, the lower the cost will be.

This project would continue to reduce the amount of energy required to heat and cool the greenhouse rooms year round. It would be sustainable economically, by reducing the University of Illinois' energy costs in the long term. It would be sustainable environmentally by emitting fewer pounds of carbon dioxide.

Energy/shade curtains cost, approximately, $10-12,500 per room to install, including materials and labor. Installation includes the drive shaft, a reversible motor, stainless steel and nylon support cables, all structural and mechanical components to mount the curtain system and reversible motor, and a controller to connect it to the existing computer-automated greenhouse control system (Argus). There will be additional costs for Argus override switches and software which has averaged $100 per room. There will also be electrical costs to connect the shade curtain motor to the Argus Control System. This cost has averaged $1350 per room.

Therefore, we are requesting funding for a total of nine (9) rooms that are 25 feet by 50 feet:

Energy/shade curtains, material and labor:	$112,500 ($12,500 per room)
Argus Control System relays and software:	$900 ($100 per room)
Electrical wiring to connect motor to controls:	$12,150 ($1350 per room)
Total costs:	**$125,550**

Based upon calculations derived by using a USDA program called "Virtual Grower", we were able to calculate the actual heating costs per square foot with and without energy/shade curtains. Please see below. This shows an approximate savings of 19.1% in steam use with energy/shade curtains with seals (boot around the perimeter to hold in the heat).

With the use of energy/shade curtains, we can decrease the use of steam to heat the rooms during the day and at night. On cloudy days, the curtains will remain open allowing maximum natural daylight for plant growth and assist in the heating of the rooms by solar radiation load. On sunny days, the curtains would close to assist in cooling the rooms; thus, reducing the load on our supply and exhaust fans. At night, the curtains would close to seal in the heat ("blanket effect"). All of this equipment is controlled by an Argus Control System which is designed specifically for greenhouses. Argus is an integrated system which monitors temperature and light levels every 10-15 minutes to minimize wear and tear on the greenhouse equipment. We estimate an overall savings of about 20% in steam use to heat the greenhouses. See the calculations provided by the "Virtual Grower" program below.

Without funding from the committee, this project will not be able to move forward for several years. Since 2001, our allocation of maintenance funds for the PSL and Turner Hall Greenhouses has decreased 34%. These maintenance funds are used for all repairs and maintenance of existing greenhouse equipment for 100 greenhouse rooms, totaling ~ 90,000 square feet of greenhouse space in the Plant Sciences Laboratory and Turner Hall Greenhouses.

Starting in 2005, we have upgraded between 3-5 rooms per year, depending upon the size of the room. However, this year other repairs have taken priority. These repairs will prohibit the installation of any curtains in FY10. Additional repairs in the PSL Conservatory may inhibit the installation of energy/shade curtains for the next several years.

We request that the SSC consider our request for an interest-free loan to cover the installation of energy/shade curtains with seals to nine greenhouse rooms to keep this energy savings upgrade moving forward. This will be dependent upon the College of ACES actually receiving credit for the energy saved in FY11. If the College of ACES will not receive any credit; then, we would like to reconsider the proposed number of rooms upgraded in FY10.

If you need any additional information, please do not hesitate to contact me at rgreen6@illinois.edu or at 217-333-3058.

Greenhouse Energy Use – No Curtains

Greenhouse 1:

Room Size: 50 ft x 25 ft with triangular roof
Heating Schedule: Jan 1 to Dec 31
Custom Schedule: 75F day/65F night (12 hr. day/12 hr. night)
Heating Efficiency: 59%
Air Exchanges: 1.3 exchanges/hour

Fuel Types and Prices - Greenhouse 1: Steam at $11.51 per lb

Total Heating Costs: $9308
Total Heating Cost per Square Foot: $7.45
Maximum BTU Draw on All Heaters: 340869 BTU/hour

Monthly BTU Usage and Heating Costs

Month	BTU	Heating Costs	Cost Per Square Foot
January	129509066	$1894	$1.52
February	99563486	$1456	$1.17
March	82536353	$1207	$0.97
April	40306558	$589	$0.47
May	21509025	$314	$0.25
June	4778940	$69	$0.06
July	2583637	$37	$0.03
August	3668466	$53	$0.04
September	13091624	$191	$0.15
October	39301690	$575	$0.46
November	75376410	$1102	$0.88
December	123976549	$1813	$1.45

Greenhouse Energy Use – With Energy/Shade Curtains with seals

Greenhouse 1:

Room Size: 50 ft x 25 ft with triangular roof
Heating Schedule: Jan 1 to Dec 31
Custom Schedule: 75F day/65F night (12 hr. day/12 hr. night)
Heating Efficiency: 59%
Air Exchanges: 1.3 exchanges/hour

Fuel Types and Prices - Greenhouse 1: Steam at $11.51 per lb

Total Heating Costs: $7534
Total Heating Cost per Square Foot: $6.03
Maximum BTU Draw on All Heaters: 334817 BTU/hour

Monthly BTU Usage and Heating Costs

Month	BTU	Heating Costs	Cost Per Square Foot
January	103935159	$1520	$1.22
February	81147361	$1187	$0.95
March	67995098	$994	$0.8
April	33404620	$488	$0.39
May	17482777	$255	$0.2
June	3967111	$58	$0.05
July	2176041	$31	$0.03
August	3070319	$44	$0.04
September	10602156	$155	$0.12
October	31114548	$455	$0.36
November	60487987	$885	$0.71
December	99571453	$1456	$1.17

Percent Savings: 19.1% per year

$ Savings per room: $1,774 per year

Savings for 9 rooms: $15,966 per year

student sustainability committee
university of illinois at urbana-champaign

February 23, 2010
College of Agricultural, Consumer and Environmental Sciences

Re: Response to Letter of Inquiry
Project: PSL Greenhouse Retrofit

Dear Ruth,

On behalf of the Student Sustainability Committee for the University of Illinois at Urbana-Champaign, I would like to thank you for responding to our call for letters of inquiry to use funds raised by the student Clean Energy Technology and Sustainability Fees to implement a project that improves the sustainability of our campus. Each letter was evaluated based on its sustainability impact (i.e. energy or sustainability impact, campus presence, project longevity, and budget) and broader impact (i.e. education and creativity). Within this round, the Committee received 45 letters requesting a total of $3.2 million – several times our annual budget.

After an evaluation, the Committee requests that you submit a proposal for funding for this project by March 15th, 2010. Please use the provided template while preparing your proposal to the Committee. Examples of past proposals can be found on our website. Your proposal should request a loan of ~$120,000 to be repaid in equal, annual installments over six years, beginning in 2012.

In addition to information requested by the template, the Committee asks that the proposal address the following:
1) Savings Verifications: Any work that will be carried out, as part of this project or separately (through a class, or as maintenance activities, etc), in order to verify that this project is achieving the expected savings
2) Repayment Source: Please discuss the sources from which repayments will be drawn. These may be energy savings, maintenance savings, fees on users in the improved facilities, College funds, etc.
3) Energy Analysis: Please discuss expected savings of energy and carbon from due to reductions in steam and electricity use. To the extent possible, use metering data to justify.

Budgets for energy use are due to be decentralized to the College level at the start of the next fiscal year. However, uncertainty remains whether this program will be implemented on schedule, especially as it was originally slated for implementation this fiscal year. We advise that you ask your Dean to inquire whether your unit will indeed see benefits from the energy savings, and then make a determination regarding whether you wish to proceed this year, or wait an additional year.

SSC Loans are generally made at the college-level or equivalent, and proposals should be submitted by the Dean or equivalent. Failure to make payments will, amongst other repercussions, make the entire College ineligible for further SSC loans and grants.

student sustainability committee
university of illinois at urbana-champaign

Thank you again for your work to make the campus more sustainable and we hope to work with you in the future.

Sincerely,

Suhail Barot,
Committee Chair

To: **Student Sustainability Committee**
University of Illinois at Urbana-Champaign

From: Ruth A. Green, Plant Care Facility Coordinator

Date: March 31, 2010

Re: Proposal for Energy/Shade Curtains for the Plant Sciences Laboratory Greenhouses

Project Lead Contact Information

Name: Ruth A. Green
E-mail: rgreen6@illinois.edu
Phone: 217-333-3058
Address: 1222 PSL, MC-634
1201 S. Dorner Drive
Urbana, IL 61801

Title: Plant Care Facility Coordinator
Organization/Department: Plant Care Facility (unit), Office of Research (Dept.)

Secondary Contact Information

Name: Ralf Moller
E-mail: rmoller@illinois.edu
Phone: 217-333-0242
Address: 220 Mumford Hall, MC-710
1301 W. Gregory Drive
Urbana, IL 61801

Title: Director of Operations
Organization/Department: College of Agricultural, Consumer and Environmental Sciences, University of Illinois at Urbana-Champaign

Unit Financial Officer Contact

Name: Natalie Bush
E-mail: mcb@illinois.edu
Title: Financial Operations Manager
Organization/Department: ACES Administration
Phone: 217-244-2842
Address: 118 Mumford Hall, MC-710
1301 W. Gregory Drive
Urbana, IL 61801

I. Detailed Project Description:

Installation of Energy/Shade Curtains in the Plant Sciences Laboratory (PSL) Greenhouse

A. Project Goals

1. Decrease energy usage to heat the greenhouse rooms
2. Decrease energy usage to cool the greenhouse rooms
3. Increase natural light quality in the greenhouse rooms
4. Decrease energy usage by the application and removal of whitewash

B. Definition of sustainability and the relationship of the project to this definition.

According to your website, you state that sustainability encompasses economic, environmental, and social practices that meet the needs of current generations without jeopardizing the ability of future generations to meet theirs.

Our project would meet this definition by reducing the amount of energy required to heat, cool and light the greenhouse rooms year round. It would be sustainable economically, by reducing the University of Illinois' energy costs in the long term. It would be sustainable environmentally by emitting fewer pounds of carbon dioxide. This project would:

1) Reduce our use of steam energy provided by Abbott Power Plant to heat the greenhouses in the winter;
2) Reduce the use of electricity by our supply and exhaust fans (louvers are pneumatic);
3) Reduce our use of high intensity lighting (electricity) by providing the highest quality of natural daylight inside the greenhouse rooms year round; and,
4) Eliminate the energy used to apply whitewash in May and whitewash remover in October, in addition to the cost of materials and labor to do these applications.

C. Feasibility evaluation. (Not applicable)

D. Longevity and/or permanence of project results on campus.

The energy/shade curtain material normally lasts 7-10 years. Then, the material will need to be replaced due to heat and UV deterioration. The curtain material is the least expensive component of the curtain installation. The results of this project will be a continued reduction of energy use by the PSL Greenhouse, both steam and electricity. This will only increase as more curtains are installed.

E. Project governance structure (if applicable) (Not applicable)

F. A Summary of communication with relevant campus administrative entities and Facilities & Services personnel.

Keith Erickson provided the energy costs for steam for my calculations. They fully support the installation of energy/shade curtains in the greenhouses. They are aware of the significant energy savings these curtains provide in the long term.

G. Location

The PSL Greenhouse is located at 1201 South Dorner Drive, Urbana, Illinois. The College of ACES has already installed shade/energy curtains in 18 of the 64 greenhouse rooms. Facilities and Services (F&S) have approved the new construction we have done thus far.

H. If applicable, comparisons to similar projects at other campuses.

State of the art institutional/research greenhouses constructed today all have energy/shade curtains to reduce energy consumption needed for heating and cooling. They also install them to provide the highest quality of natural light levels to reduce the use of high intensity lighting year round.

II. Budget & Fundraising:

1. Detailed budget.

Energy/shade curtains cost, approximately, $12,000 per room to install, including materials and labor. The XLS15 Revolux curtain material made by LS is for energy savings and shading (see attachment). Installation includes the drive shaft, a reversible motor, stainless steel and nylon support cables, all structural and mechanical components to mount the curtain system and motor, and a controller to connect it to the existing computer-automated greenhouse control system (Argus). There will be additional costs for Argus override switches and software which has averaged $100.00 per room. There will also be electrical costs to connect the shade curtain motor to the Argus Control System. This has averaged approximately $1350.00 per room.

We are requesting funding for a total of nine (9) greenhouse rooms (3 ranges):

Energy/shade curtains, material and labor:	$108,000.00 ($12,000.00 per room)
Argus Control System relays and software:	900.00 ($100.00 per room)
Electrical wiring to connect motor to controls:	12,150.00 ($1350.00 per room)
Total costs:	**$121,050.00**

Life-cycle operation and maintenance costs would consist of the operation of a 24-volt signal from the Argus Control System telling the curtain motor to open or close. It is an integrated control system that monitors the room temperature, outside light levels and desired light intensity setting for the crop being grown, and decides if it will continue to open or close the curtains in order to maintain the desired light levels and temperature settings. Annual maintenance includes checking that all of the support cables are tight and the motor is not leaking oil.

We would like to install energy/shade curtains in ranges 1400, 1500 and 1600 on the west side of the PSL Greenhouse. There are three rooms in each range and each room is 25 feet wide and 50 feet long. Thus, there are nine (9) rooms all the same in size. The knee wall is 3 feet tall, the gutter height is 10 feet tall, the ridge height is 17.5 feet tall and the tempered glass is 1/8 inch thick with a 6/12 pitch.

Without funding from the committee, this project will not be able to move forward. Our allocation of maintenance funds for the PSL and Turner Hall Greenhouses has decreased annually from $131,000.00 in 2001 to $87,000.00 in 2009. These maintenance funds are used for all repairs and maintenance of existing greenhouse equipment for 100 greenhouse rooms, totaling ~ 90,000 square feet of greenhouse space in the PSL and Turner Hall Greenhouses, excluding the new USDA addition. We have been able to upgrade, approximately, five (5) rooms per year since FY06. Facilities and Services have supported the installation of this new equipment. However, in FY10, we had other costly repairs that took precedence over this upgrade project. Given the state budget situation, it is expected that additional state budget cuts are coming for FY11. Therefore, this will halt the progress of this upgrade project.

2. Fundraising

Currently, as stated above, the College of ACES allocates, approximately, $87,000 per year for maintenance, repairs and upgrades for the PSL and Turner Hall Greenhouses. We did apply for a grant from the Specialty Growers of Illinois in FY05 and were awarded $10,000.00 to replace the blackout curtains in one of the rooms in the

Turner Hall Greenhouse which had completely failed. We have been looking for other funding/granting opportunities since that time. We also have funds available through the PCF Service Account as "matching funds" which many granting agencies require. The PCF Advisory Committee just approved a greenhouse service fee increase that will take effect on July 1, 2010. These funds could help repay this interest-free loan.

We request that the SSC consider our request for an interest-free loan to cover the installation of energy/shade curtains with seals to nine greenhouse rooms to keep this energy savings upgrade moving forward. This will be dependent upon the College of ACES actually receiving funds for the energy saved in FY11 and beyond. If the College of ACES does not receive any funds; then, we would like to reconsider the proposed number of rooms upgraded in FY11. The number of rooms could be decreased to "0" due to the uncertainty and the unclear campus policy in this matter.

III. Timeline

A. Detailed Timeline

Our project is dependent on the receipt of funding from this committee. If the University of Illinois experiences additional state budget cuts, the amount of maintenance funds allocated per year could continue to decline, thus, decreasing our ability to pay for these long-term energy upgrades. Our greenhouse facilities are only getting older, and will require more repairs and/or replacement of equipment, not less.

Normally, we do these installations in March or April because we need them fully operational by May. It normally takes the contractor one week to install five curtain systems. It takes another week for the electrical work to be done to connect the new curtain motor to the Argus Control System. Therefore, to install nine new curtain systems may take a total of one month.

For example, the last five rooms were done starting on April 27, 2009, and the contractor planned to be done on Friday, May 1, 2009. Our F&S electrician started the electrical work on May 4, 2009, and completed the wiring by May 10, 2009. Our target start and end dates for this installation would be April 12 to May 7, 2011.

IV. Energy, Environmental, Social and Economic Impact

A. Renewable Energy Projects – Not applicable.

B. Energy Efficiency Projects – Applicable.

a. We tried to obtain energy usage costs for the PSL Greenhouse from 2003 to 2008 from F&S. Because of a faulty steam valve meter, F&S did not have any steam use data for the PSL Greenhouse, individually. We were able to obtain energy use data for the entire Plant Sciences Laboratory Building from June 2009 to February 2010. **See energy usage attached.**

Based on industry standards, shade and/or energy curtains can save, approximately, 20-55% in energy use depending upon the type of material used and how it is installed. We estimate that the energy savings by installing energy/shade curtains in three ranges of rooms in the PSL Greenhouse will average approximately 15-21% energy

savings. **This is a conservative estimate.** As of May 1, 2009, we have energy/shade curtains in three ranges of the PSL Greenhouse including 18 of the 64 greenhouse rooms.

According to the energy estimates attached, we would be able to save 141 klb of steam per room or 1267 klb of steam for 9 rooms. This is equal to a 21% savings in steam used to heat these 9 greenhouse rooms. This would eliminate 310,288 lb. of carbon dioxide emissions per year. In dollars, we would save $2.22 per square foot which equals $2775.00 per room. Thus, this would be a yearly savings of $24,975 for all 9 rooms. This is equivalent to a 21% savings in energy costs.

b. The curtain systems themselves need electricity to power a reversible motor which draws 1 amp (equivalent to a 100 watt bulb, as per Tom Weber with F&S) and the controller connected to the greenhouse environmental control system (Argus). Argus sends out a 24-volt signal to the relay which signals the curtain motor to open or close the curtain based upon room temperature, outside light levels and the light intensity required by the crop being grown. Argus is an integrated system which monitors all of these factors every 10-15 minutes. This is done to minimize wear and tear on the equipment. The motor runs, approximately, 30 seconds to open or close the curtain.

In addition to saving on steam usage, these energy/shade curtains also save on cooling costs, because they reduce indoor light intensity and help control room temperatures during the day. This reduces the amount of electricity used by the supply and exhaust fans, and the use of high intensity lighting (HID lights). On a rainy or cloudy day, the curtains would remain wide open to provide the maximum amount of natural daylight. The same room with whitewash would be extremely dark which would cause the HID lights to run more hours per day than a room with energy/shade curtains.
I do not have any electrical data as proof since we do not have any electrical meters for any individual greenhouse rooms with and without curtains.

Also, the installation of energy/shade curtains eliminates the recurring cost of materials, labor, and electrical energy to apply and remove whitewash. This costs the Plant Care Facility (PCF), approximately, $3,000.00 per year in materials and 40 labor hours to apply the whitewash in May and another 40 labor hours to apply the whitewash remover in October. That is a total of 80 hours of labor which averages about $1,800.00 per year. The whitewash is applied using a 15-gallon electrical sprayer.

c. We believe the net amount of energy saved would be a **minimum of 20%** per year because of the combined savings in steam and electrical usage. These savings would continue to increase on an annual basis as more curtains are installed.

C. All Projects

a. Environmental Impact

If we were able to save 1267 klbs of steam annually, this would reduce carbon dioxide emissions by 310,288 lb. per year.

b. Social Impact

The greenhouses serve the needs of researchers and faculty who teach and conduct plant laboratories inside the greenhouse. The energy/shade curtains make the greenhouse rooms a more pleasant environment in which to work by keeping the room temperatures cooler and reducing light intensity and glare.

c. Economic Impact

On the negative side, these curtain systems are expensive to install at approximately $13-14,000.00 per room. However, on the positive side, these curtain systems will minimize the wear and tear on our heating and cooling equipment, provide a much higher quality of light for plant growth, reduce the use of high intensity lighting, and eliminate the annual cost and labor to apply and to remove whitewash.

V. Outreach and Education

Many classes use the greenhouses on a weekly basis for class laboratories in the departments of NRES, Crop Sciences and Plant Biology. We also have students in Agricultural Engineering and Food Science who use our greenhouses for classes and research projects. Dozens of graduate students in NRES and Crop Sciences use the greenhouses for their masters and PhD research projects on an annual basis. At least half of the people we serve in the greenhouses are undergraduate and graduate students.

The students would not play a direct role in this project, but the faculty, staff and students conducting research or plant production in the greenhouses would benefit directly from the improved growing conditions provided by these energy/shade curtains.

Many faculty members in the Departments of NRES, Crop Sciences and Plant Biology utilize the greenhouses as part of their classroom curriculum by taking students on tours to teach them about greenhouse management and operations, having students grow plants in the greenhouses to teach plant production methods, or to teach them insect identification and integrated pest management methods.

The local media uses the greenhouses on a regular basis to cover research in progress, seasonal crops being grown such as poinsettias and spring bedding plants, and tropical plants spotlighted in the PSL Conservatory.

The PCF and Plant Biology greenhouse staff conduct dozens of tours each year to elementary, secondary, high school and junior college students to educate them about greenhouse operations and management, plant identification, and plant production methods. We also give dozens of tours to community groups, not-for-profit organizations, and private sector industry. These tours are wonderful opportunities to share the many ways the greenhouses are striving to reduce energy usage.

Greenhouse 1 -- No Curtains

Greenhouse 1: Triangular: 50 ft x 25 ft

Heating Schedule

Jan 1 to Dec 31 During the Day: 75 During the Night: 65 ºF

Heating Efficiency: 74%

Air Exchanges: 1.85 exchanges/hour

Fuel Types and Prices

Greenhouse 1: Steam at $19.75 per lb

Total Heating Costs: $13284

Total Heating Cost per Square Foot: $10.63

Maximum BTU Draw on All Heaters: 351454 BTU/hour

Monthly BTU Usage and Heating Costs

Month	BTU	Heating Costs	Cost Per Square Foot
January	132786575	$2657	$2.13
February	103258959	$2066	$1.65
March	86917149	$1739	$1.39
April	43799225	$876	$0.7
May	25009415	$500	$0.4
June	6534793	$130	$0.1
July	3930054	$78	$0.06
August	4131970	$82	$0.07
September	14014609	$280	$0.22
October	40038462	$801	$0.64
November	76596083	$1533	$1.23
December	126662795	$2535	$2.03

Greenhouse 1 With Energy/Shade Curtains

Greenhouse 1: Triangular: 50 ft x 25 ft, with energy curtain

Heating Schedule

Jan 1 to Dec 31 During the Day: 75 During the Night: 65 ºF

Heating Efficiency: 74%

Air Exchanges: 1.85 exchanges/hour

Fuel Types and Prices

Greenhouse 1: Steam at $19.75 per lb

Total Heating Costs: $10511

Total Heating Cost per Square Foot: $8.41

Maximum BTU Draw on All Heaters: 351454 BTU/hour

Monthly BTU Usage and Heating Costs

Month	BTU	Heating Costs	Cost Per Square Foot
January	103732921	$2076	$1.66
February	82036172	$1642	$1.31
March	70023268	$1401	$1.12
April	35597726	$712	$0.57
May	20225399	$404	$0.32
June	5570118	$111	$0.09
July	3445866	$68	$0.06
August	3421124	$68	$0.05
September	11086886	$221	$0.18
October	30889202	$618	$0.49
November	59989530	$1200	$0.96
December	99091953	$1983	$1.59

	85%	78%
XLS 13 FIREBREAK	70%	65%
XLS 14 FIREBREAK	56%	53%
XLS 15 FIREBREAK	46%	43%
XLS 16 FIREBREAK	36%	34%
XLS 17 FIREBREAK	25%	24%
XLS 18 FIREBREAK	18%	17%

Solar Reflection Screens

XLS F FIREBREAK screens are necessary when too
exist and maximum ventilation is desired. Hot air easi
between the reflective aluminium strips. Closing the s
temperatures by reflection radiation back toward the p
leaf condensation.

Type	Light transmission	
	Direct	Diffuse
XLS 14 F FIREBREAK	59%	56%
XLS 15 F FIREBREAK	50%	47%
XLS 16 F FIREBREAK	39%	37%
XLS 17 F FIREBREAK	27%	27%
XLS 18 F FIREBREAK	19%	19%

LS Climate Control | Inside Screens

LIVING SHADE

LS Climate Control Pty Ltd
Phone: 61 2 9477 6955
Fax: 61 2 9477 5506
Email: info@livingshade.com.au

PRODUITS SUENSSON
EN DATE DU 15/09/2008

Inside Screens

Energy Saving Screens

Purpose: Energy savings, air humidity control.

SLS 10 ULTRA PLUS and XLS 10 FIREBREAK transparent screens are designed to retain the maximum amount of heat with a minimal loss of light. These screens are ideal for vegetable production in colder climates. The SLS 10 ULTRA PLUS screen contains light diffusing films promoting better light distribution and even leaf temperatures. The XLS 10 FIREBREAK screen is clear and saves more energy. The XLS Blackout FIREBREAK screen is a fully aluminium screen for maximum night time heat retention.

Type	Light transmission		Energy saving
	Direct	Diffuse	
SLS 10 ULTRA PLUS	88%	81%	43%
XLS 10 FIREBREAK	85%	78%	47%

Energy Saving, Solar Reflection Screens

Purpose: Energy saving, solar reflection

XLS FIREBREAK screens provide a prescribed level of shading by reflecting unwanted solar energy away from the crop. When closed at night, the screens trap heat beneath. Energy savings increase as aluminium content increases.

Type	Light transmission		Energy saving
	Direct	Diffuse	
XLS 10 FIREBREAK			

Produits Svensson
En date du 15/09/2008

Inside Screens

Energy Saving Screens

Purpose: Energy savings, air humidity control.

SLS 10 ULTRA PLUS and XLS 10 FIREBREAK transparent screens are designed to retain the maximum amount of heat with a minimal loss of light. These screens are ideal for vegetable production in colder climates. The SLS 10 ULTRA PLUS screen contains light diffusing films promoting better light distribution and even leaf temperatures. The XLS 10 FIREBREAK screen is clear and saves more energy. The XLS Blackout FIREBREAK screen is a fully aluminium screen for maximum night time heat retention.

Type	Light transmission		Energy saving
	Direct	Diffuse	
SLS 10 ULTRA PLUS	88%	81%	43%
XLS 10 FIREBREAK	85%	78%	47%

LS Climate Control Pty Ltd
Phone: 61 2 9477 6955
Fax: 61 2 9477 5506
Email: Info@livingshade.com.au

Energy Saving, Solar Reflection Screens

Purpose: Energy saving, solar reflection

XLS FIREBREAK screens provide a prescribed level of shading by reflecting unwanted solar energy away from the crop. When closed at night, the screens trap heat beneath. Energy savings increase as aluminium content increases.

Type	Light transmission		Energy saving
	Direct	Diffuse	
XLS 10 FIREBREAK			

	85%	78%	47%
XLS 13 FIREBREAK	70%	65%	49%
XLS 14 FIREBREAK	56%	53%	52%
XLS 15 FIREBREAK	46%	43%	57%
XLS 16 FIREBREAK	36%	34%	62%
XLS 17 FIREBREAK	25%	24%	67%
XLS 18 FIREBREAK	18%	17%	72%

Solar Reflection Screens

XLS F FIREBREAK screens are necessary when too high greenhouse temperatures exist and maximum ventilation is desired. Hot air easily flows through the screen between the reflective aluminium strips. Closing the screen at night will elevate leaf temperatures by reflection radiation back toward the plants, inhibiting undesirable leaf condensation.

Type	Light transmission		Energy saving
	Direct	Diffuse	
XLS 14 F FIREBREAK	59%	56%	20%
XLS 15 F FIREBREAK	50%	47%	20%
XLS 16 F FIREBREAK	39%	37%	25%
XLS 17 F FIREBREAK	27%	27%	30%
XLS 18 F FIREBREAK	19%	19%	35%

Flame Retardant Screens

REVOLUX flame retardant screens deliver the same climate improvements as above, with added fire security. REVOLUX screens are typically required to meet building code standards for garden centres, production greenhouses, institutions and some commercial structures. XLS REVOLUX screens are suited for sliding and hanging systems whereas ILS REVOLUX screens are available for rolling applications.

Type	Light transmission		Energy saving
	Direct	Diffuse	
XLS 10 REVOLUX	84%	75%	45%
XLS 15 REVOLUX	45%	41%	55%
XLS 16 REVOLUX	37%	34%	60%
XLS 17 REVOLUX	31%	29%	65%
ILS 60 REVOLUX A/A/G	20%	17%	60%
XLS 17 F REVOLUX	31%	28%	27%

For more information visit the Svensson company website

LIVING SHADE

CLIMATE CONTROL PRODUCTS

SVENSSON PRODUCTS

- INSIDE SCREENS
- OUTSIDE SCREENS
- OUTSIDE SCREENS FOR DOMESTIC USE
- SVENSSON SCREENS
- VARIABLE SCREENING
- SVENSSON SLIDE SYSTEM
- ENVIRONMENTAL CONTROL SYSTEMS

GREENHOUSE COVER

CIRCULATION FANS

INSECT SCREENS

CAPILLARY MATS

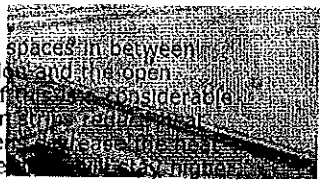
GROUND COVER

Outside Screens

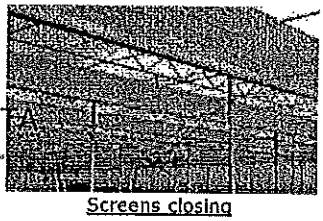
The OLS range of Svensson® screens is produced for shading greenhouses from the outside and protects against sun radiation, frost, hail, downpour and wind.

OLS ABRI external screens are suitable to protect outdoor crops against certain adverse weather conditions such as strong sunshine, night frost, hail, downpour and wind. The strong monofilament yarns used guarantee a long useful life, even under severe weather conditions.

The screen is reinforced in such a way that one can hang it onto polyester or steel wires with special synthetic suspension hooks. In this way the screen can be completely opened and closed so that it is possible to react adequately to changing weather conditions.



OLS ABRI screens consist of aluminium strips with open spaces in between these strips. The strips that reflect unwanted sun radiation and the open structure allow for sufficient airflow. The overall result of this is a considerable reduction of daytime crop temperature. As the aluminium strips reflect heat radiation from escaping the greenhouse, OLS ABRI screens also reduce heat loss from the crop during night-time: As the plant temperature will stay higher the night frost damage will be limited to a minimum.



Screens closing

AVAILABLE TYPES AND TECHNICAL DATA

Type	Light	Transmission	Energy saving
	Direct	Diffuse	
OLS 35 ABRI	69%	61%	20%
OLS 50 ABRI	49%	42%	25%
OLS 60 ABRI	36%	30%	30%
OLS 70 ABRI	25%	25%	35%

LS Climate Control Pty Ltd
Phone: 61 2 9477 6955
Fax: 61 2 9477 5506
Email: info@livingshade.com.au

Related Pages

Solar Ultra Plastic Greenhouse Covers

EMAIL US

LIVING SHADE

CLIMATE CONTROL PRODUCTS

SVENSSON PRODUCTS

- INSIDE SCREENS
- OUTSIDE SCREENS
- OUTSIDE SCREENS FOR DOMESTIC USE
- SVENSSON SCREENS
- VARIABLE SCREENING
- SVENSSON SLIDE SYSTEM
- ENVIRONMENTAL CONTROL SYSTEMS

GREENHOUSE COVER

CIRCULATION FANS

INSECT SCREENS

CAPILLARY MATS

GROUND COVER

LS Climate Control Pty Ltd
Phone: 61 2 9477 6955
Fax: 61 2 9477 5506
Email: Info@livingshade.com.au

Outside Screens for Domestic Use

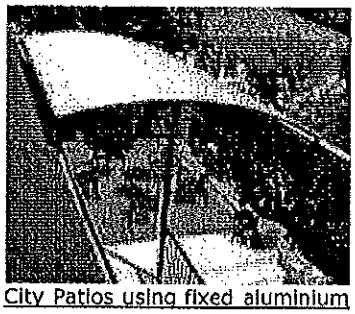
Solar Reflection Screens

OLS screens are designed to withstand and protect against elements of direct outdoor exposure including harsh sun, wind, hail and heavy downpours. OLS screens are commonly used in a fixed manner or in rolling applications over verandahs, patios and courtyards.

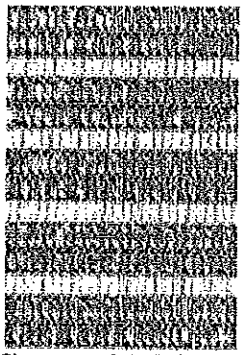
OLS screens consist of aluminium strips with open spaces in between these strips. The strips reflect unwanted sun radiation and the open structure allows for sufficient airflow.

The overall result of this is a considerable reduction of temperature under the covered area and you can feel up to 12oC cooler. At night-time as the aluminium strips reduce heat radiation from the area, OLS screens decrease the heat loss and you will feel up to 6oC warmer.

The same process occurs with all our outside living areas and everybody under these screens feel the immediate cooling effect and say "What a great product".

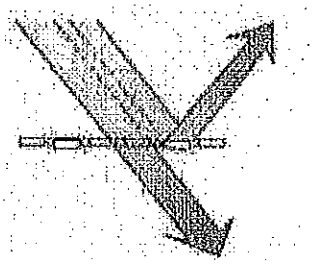


City Patios using fixed aluminium screens



Close up of OLS Screen

Type	Light transmission		Energy saving
	Direct	Diffuse	
OLS 50	49%	42%	20%
OLS 60	36%	30%	25%
OLS 70	25%	25%	30%



For more information visit the Svensson company website

INSIDE

Type of screen	Svensson® Screen	Direct transmission %	Diffused transmission %	Energysaving %	Type installation
SVENSSON® ENERGY SAVING SCREENS	SLS 10 ULTRA PLUS	88	81	43	SH
	XLS A/A	3	3	75	SH
	XLS 10	85	78	47	SH
SVENSSON® ENGERGY SAVING SOLAR REFLECTION SCREENS	XLS 13	70	65	49	SH
	XLS 14	56	53	52	SH
	XLS 15	46	43	57	SH
	XLS 16	36	34	62	SH
	XLS 17	25	24	67	SH
	XLS 18	18	17	72	SH
SVENSSON® SOLAR REFLECTION SCREENS	XLS 14 F	59	56	20	SH
	XLS 15 F	50	47	20	SH
	XLS 16 F	39	37	25	SH
	XLS 17 F	27	27	30	SH
	XLS 18 F	19	19	35	SH
SVENSSON® FLAME RETARDANT SCREENS	XLS 10 REVOLUX	84	75	45	SH
	XLS 15 REVOLUX	44	39	55	SH
	XLS 16 REVOLUX	37	34	60	SH
	XLS 17 REVOLUX	31	29	65	SH
	XLS 15 F REVOLUX	46	43	20	SH
	XLS 17 F REVOLUX	33	31	30	SH
	XLS 17 REVOLUX A/G	30	27	65	SH
	XLS 17 REVOLUX A/BLUE	30	27	65	SH
	XLS 17 REVOLUX A/Y	30	27	65	SH
	XLS 17 REVOLUX A/O	30	27	65	SH
	ILS 60 REVOLUX A/A/G	20	17	60	R
	ILS 70 REVOLUX A/A/G	16	13	65	R
	XLS OBSC. REV. A/B+B/B	<0,1	<0,1	75	SH
SVENSSON® BLACKOUT SCREENS	XLS OBSCURA A/B+B/B	<0,1	<0,1	75	SH
	XLS OBSCURA A/B+B/W	<0,1	<0,1	75	SH
	LS 100	<0,1	<0,1	43	SH
SVENSSON® ASSIMILATION SCREENS	XLS OBSCURA B/W	<1	<1	40	SH
	XLS OBSCURA 19 W/W	11	10	40	SH
SVENSSON® ROLLING SCREENS	ILS ULTRA	87	77	45	R
	ILS 40 ULTRA	63	56	50	R
	ILS 50 ULTRA	48	43	55	R
	ILS 60 ULTRA	34	31	60	R
	ILS 70 ULTRA	25	20	65	R
	ILS 80 ULTRA	22	21	70	R
	ILS A/A	3	4	70	R
	ILS CLEAR	83	77	47	R
SVENSSON® BLACKOUT ROLLING SCREENS	ILS HORTIROLL A/W/G	0	0	70	R
	ILS HORTIROLL W/W	0	0	70	R

OUTSIDE

SVENSSON® SOLAR REFLECTION SCREENS	OLS 50	49	42	20	R
	OLS 60	36	30	25	R
	OLS 70	25	25	30	R
	OLS 35 ABRI	69	61	20	H
	OLS 50 ABRI	49	42	25	H
	OLS 60 ABRI	36	30	30	H
	OLS 70 ABRI	25	25	35	H
SVENSSON® GREENHOUSE COVER	OLS ABRI	79	71		H
	LS SOLARWOVEN ULTRA	85	78		R
	LS SOLARWOVEN GREEN	46	36		R

INSECT NET

Type of net	Svensson® Screen	Direct transmission %	Diffuse transmission %	Opening	Ventilation reduction
SVENSSON® INSECT NET	LS ECONET B	90	82	1,00 x 4,00	5%
	LS ECONET F	90	77	0,45 x 0,78	25%
	LS ECONET L	84	76	0,60 x 0,60	25%
	LS ECONET M	90	79	0,40 x 0,45	30%
	LS ECONET T	85	79	0,15 x 0,35	40%
	LS ECONET SF	88	75	0,28 x 0,78	30%
	LS ECONET S	91	76	0,15 x 0,15	45%

GROUNDCOVER

Type of groundcover	Svensson® Screen	Standardwidth (m)	Water permeability
SVENSSON® GROUNDCOVER	LS GROUNDCOVER WHITE	3,30/ 3,50/4,15/5,15	8,0 l/m²/s
	LS GROUNDCOVER BLACK	3,30/ 3,50/4,15/5,15	8,0 l/m²/s
	LS GROUNDCOVER BLACK PLUS	3,30/ 4,15/5,15	8,0 l/m²/s

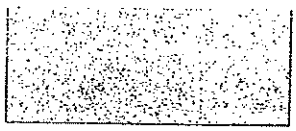
Type of installations: S = Sliding H = Hanging R = Rolling

LS Fabrics for Interior VRE Shade & Save Systems

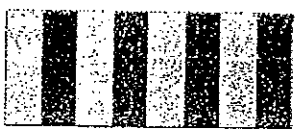
Available types and technical data:

Type	Light transmission Direct	Diffuse	Energy saving
XLS 10	85%	78%	47%
XLS 13	70%	65%	49%
XLS 14	56%	53%	52%
XLS 15	46%	43%	57%
XLS 16	36%	34%	62%
XLS 17	25%	24%	67%
XLS 18	18%	17%	72%

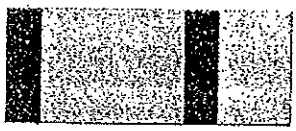
XLS 10



XLS 15

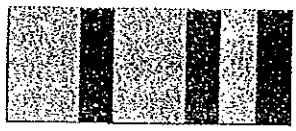


XLS 13

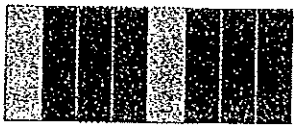


XLS 16

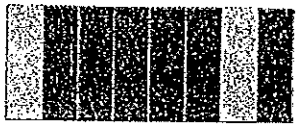
XLS 14



XLS 17



XLS 18



Standard widths:

3.20, 3.50, 4.30, 4.70 and 5.30m; other widths available on demand.

Warranty:

5 years under all types of house covering, also UV-transparent, as per Svensson limited warranty in writing.

ENG **Purpose:** Energy saving, Solar reflection.

TOP SYSTEMS – SHADE REGULAR FABRIC

Characteristics:

XLS is made of 4mm wide aluminium and polyester strips held together with a strong polyester filament yarn. Special aluminium and polyester give XLS its superior reflection and transmission efficiency. This guarantees a low daytime temperature as well as very high energy savings, and keeps the crop temperature close to the ambient temperature during the night. The result is a better climate in the greenhouse with minimum risk for dew formation on the leaves, reducing disease problems and lowering the energy costs.

The knitted structure allows sufficient water vapour to pass through, preventing condensation drops to form on the underside of the screen. The flexible structure also allows the screen to be folded into a very small package in an open position, making a maximum light transmission possible.

XLS is an inside screen for all types of greenhouses and greenhouse covering materials. It is used for overhead installations, sliding as well as hanging.

As XLS is a highly UV stabilised product with excellent antistatic properties, the screen will stay clean and efficient for many years. The applied UV stabilisers are resistant to all common chemicals used in greenhouses.

TOP SYSTEMS - SHADE
FIRE RETARDANT FABR

ENG **Purpose:** Fire security, Energy saving, Solar reflection, Decoration.

Characteristics:

XLS REVOLUX screens are meant for situations where fire security is of great importance, for example in public areas.Opposed to most other screens used in the horticulture industry, these screens are manufactured from 100% flame retardant materials. Test reports by institutions from various countries concerning the fire resistant properties are available.

XLS REVOLUX is made of 4mm wide aluminium and polyester strips held together with a strong polyester filament yarn. Special aluminium and polyester give XLS REVOLUX its superior reflection and transmission efficiency. This guarantees a low daytime temperature as well as very high energy savings, and keeps the crop temperature close to the ambient temperature during the night. The result is a better climate in the greenhouse with minimum risk for dew formation on the leaves, reducing disease problems and lowering the energy costs.

The knitted structure allows sufficient water vapour to pass through, preventing condensation drops to form on the underside of the screen. The flexible structure also allows the screen to be folded into a very small package in an open position, making a maximum light transmission possible.

XLS REVOLUX is an inside screen for all types of greenhouses and greenhouse covering materials. It is used for overhead installations, sliding as well as hanging.

As XLS REVOLUX is a highly UV stabilised product with excellent antistatic properties, the screen will stay clean and efficient for many years. The applied UV stabilisers are resistant to all common chemicals used in greenhouses.

Available types and technical data:

Type	Light transmission		Energy
	Direct	Diffuse	saving
XLS 10 REVOLUX	84%	75%	45%
XLS 15 REVOLUX	53%	49%	55%
XLS 16 REVOLUX	37%	34%	60%
XLS 17 REVOLUX	31%	29%	65%

XLS REVOLUX is also available in four different colours: orange, yellow, blue and green.

Standard widths:

3.50 m; other widths available on demand.

Warranty:

5 years under all types of house covering, also UV-transparent, as per Svensson limited warranty in writing.

ROLLING SCREENS

SIDE WALL ROLL-UPS

NON FIRE RETARDANT

ILS Ultra
ILS 50 Ultra
ILS 60 Ultra
ILS 70 Ultra
ILS ALU

Purpose: Solar reflection
Energy saving

ILS roller screens are specially designed for use in roller screen installations intended for screening both the roof, the outer and separating walls of your greenhouse. The rigid structure ensures problem-free rolling up and down, even on frequent use.

A sophisticated combination of aluminium and transparent strips makes these screens suitable for both solar reflection and energy saving. The aluminium reflects sharp sunlight and retains heat radiation at night. The result is a more uniform growth climate for your crop, a more agreeable working climate for your personnel and appreciable savings on heating cost at night.

By using ILS roller screens along the outer walls of your house you will avoid undesirable horizontal temperature differences.

Warranty:
As per LS written 5 year limited warranty.

Standard widths:
1.90, 2.10, 2.30 and 4.20 m.
NB: By cutting or sewing, virtually any required width can be supplied.

Technical data:

Type	Shade value	Energy saving
ILS Ultra	20%	43%
ILS 50 Ultra	50%	55%
ILS 60 Ultra	65%	60%
ILS 70 Ultra	75%	65%
ILS ALU	99%	75%

Assembly instructions available on request.

ILS REVOLUX

SIDE WALL ROLL UP
FIRE RETARDANT
SHADE FABRIC

ENG **Purpose:** Fire security, Energy saving, Solar reflection, Decoration.

Characteristics:

ILS REVOLUX rolling screens are specially designed for use in roller screen applications, for greenhouse roofs, outer and dividing walls. The strengthened knit structure ensures a smooth rolling up and down of the screen, even after frequent use.

ILS REVOLUX rolling screens are meant for situations where fire security is of great importance, for example in public areas like retail nurseries.

ILS REVOLUX screens are made of aluminium and transparent synthetic strips. In a closed position the screen retains the radiant and convective heat. This results directly into energy savings. The ILS REVOLUX screens also reflect the required amount of the sun's radiation, protecting the crop from fierce radiation and stressful temperatures. Both of these properties result in a more comfortable working climate for the crop, public and personnel.

In order to achieve a decorative effect, ILS REVOLUX uses a green monofilament.

Condensation will not occur, therefore the screen will remain algae free and clean for many years.

Available types and technical data:

Type	Light transmission		Energy
	Direct	Diffuse	saving
ILS 60 A/A/G REVOLUX	20%	17%	60%
ILS 70 A/A/G REVOLUX	16%	13%	65%

ILS REVOLUX can be supplied in an F version, which is open to increase the ventilation.

Standard widths:

1.40, 1.90, 2.10, 2.30 and 4.20 m. Other widths available on demand.

Warranty:

5 years under all types of house covering, also UV-transparent, as per Svensson limited warranty in writing.

TOP SYSTEMS -
BLACK-OUT

XLS OBSCURA A/B + B/B and A/B + B/W

ENG **Purpose:** Day length control, Energy saving

Characteristics:

The XLS OBSCURA screens consist of two layers: a 100% aluminium top layer and a black bottom layer. For all sensitive crops needing day length control, like chrysantemum, kalanchoe or euphorbia, the blackout effect is more than sufficient, with light transmission <0.1%.

Sunlight is reflected by the aluminium upper surface. Therefore when the weather is sunny, undesired heat accumulation is excluded during blackout periods.

Even with two layers of material, the folded package is very small in opened position. This permits a maximum amount of light to reach the crops.

XLS OBSCURA screens allow for sufficient water vapour permeation. Closing the screen therefore leads to a minimal rise of the air humidity and condensation drops do not form on the underside of the screen.

There are two types of XLS OBSCURA screens available:
XLS OBSCURA A/B + B/B: The bottom layer is black
XLS OBSCURA A/B + B/W: The bottom layer is black on the top and white on the bottom.

This white surface allows for 60% light reflection, therefore in combination with artificial light, a 3 to 5% increase in the amount of light may be achieved.

Available types and technical data:

Type	Light transmission		Energy
	Direct	Diffuse	saving
XLS OBSCURA A/B+B/B	<0.1%	<0.1%	75%
XLS OBSCURA A/B+B/W	<0.1%	<0.1%	75%

Standard widths:

3.20, 3.50, 4.30 and 4.70m; other widths available on demand.

Warranty:

5 years under all types of house covering, also UV-transparent, as per Svensson limited warranty in writing.

SIDE WALL ROLL-UPS
BLACK-OUT

ILS HORTIROLL A/W – W/W

ENG **Purpose:** Blackout, Energy saving, Light reflection.

Characteristics:

ILS Hortiroll is a rolling screen, specially designed to blackout the sidewall of a greenhouse. It is also used as a dividing wall between greenhouse sections. One can make a blackout installation complete, by combining the ILS Hortiroll rolling screen with a horizontal Svensson Obscura screen.

There are two versions of the ILS Hortiroll: ILS Hortiroll A/W is used for sidewalls. It has an aluminium outer surface and a white inner surface. A green monofilament yarn gives the outside surface a more natural and decorative effect. ILS Hortiroll W/W is used for dividing walls. This rolling screen is white on both sides.

ILS Hortiroll is also the right choice when you are obliged to maintain artificial light within the greenhouse. The white surface reflects light back diffused onto the crop, ensuring uniform crop development.

Available types and technical data:

Type	Light transmission Direct	Diffuse	Shade value	Energy saving
ILS Hortiroll A/W	0%	0%	100%	70%
ILS Hortiroll W/W	0%	0%	100%	70%

Standard widths:

1.90m and 2.40m

Warranty:

5 years under all types of house covering, also UV-transparent, as per Svensson limited warranty in writing.

INSECT SCREENING

ENG **Purpose:** Keep out harmful insects, Retain useful insects.

Characteristics:

LS ECONET insect nets are woven from UV-stabilised polyethylene and acrylic yarns. These materials guarantee a long working life even when used outside.

In order to offer an adequate solution for every situation, there are six different types available. Each type with a different hole size.

Various types of LS ECONET have rectangle openings instead of square openings. The advantage is that with a similar protection grade against insects, there is more open surface available than with square openings, resulting in better ventilation.

Available types and technical data:

Type	Light transmission		Hole size	Ventilation
	Direct	Diffuse	mm	reduction
LS ECONET B	90%	82%	1.0x4.0	5%
LS ECONET F	90%	77%	0.45x0.78	25%
LS ECONET L	84%	76%	0.60x0.60	25%
LS ECONET M	90%	79%	0.40x0.45	30%
LS ECONET T	85%	79%	0.15x0.35	40%
LS ECONET SF	88%	75%	0.28x0.78	30%

Standard widths:

LS ECONET B	4.20m
LS ECONET L	3.20m
LS ECONET M	2.00 and 3.30m
LS ECONET S and T	3.40m
LS ECONET F and SF	3.15m

Other widths available on demand.

Warranty:

Outdoor use 3 years. 5 years under all types of house covering, also UV-transparent, as per Svensson limited warranty in writing.