Market Study of Energy Efficient Windows in Poland

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Warsaw 1996

1. INTRODUCTION

Just a few years ago, wood was the material typically used in window frame production in Poland. The quality of the common, inexpensive window was low. Then, the availability of materials such as PVC and aluminum allowed window manufacturers to seek new technologies and other means to improve product quality. Progress in glass production technology, most significantly the advent of double- and triple-glazed units, also led to better window quality.

2. STATISTICAL INFORMATION

2.1 Construction Industry in Poland, 1992-1995

Table 1 presents the number of apartments occupied or used from 1992-1995:

Table 1 Residential Building Stock and Construction in Poland, 1992-1995

	1992	1993	1994	1995
Number of flats in-use (thousands)	11278.4	13365.9	11443.9	11487.0
Number of rooms used (thousands)	38654	39038	39350	39606
New flats (thousands)	133.8	94.4	76.1	61.0
New rooms (thousands)	551.4	404.8	340.6	276.0

In the same period, industrial building construction can be characterized as follows:

Table 2 Industrial Building Construction, 1992-1995

	1992	1993	1994	1995
Industrial buildings	4051	2680	2577	2433

Commercial and municipal construction from 1992-1995 is presented in Table 3:

Table 3 Commercial Building Construction, 1992-1995

	1992	1993	1994	1995
Schools and kindergartens	413	509	481	480
Hospitals, ambulatories	162	192	147	na
Trade and services	5482	3898	3659	na
Hotels and restaurants	341	361	352	na
Public administration	257	247	244	na
Banks, insurance	162	136	122	na
Transportation	258	211	214	na
Other buildings	7915	2264	2301	na

na - not available in November 1995

Table 4 presents the distribution of inhabited residential buildings by vintage.

Table 4 Distribution of Inhabited Buildings by Vintage

Vintage	Urban	rural
Before 1918	13.5 %	13.4 %
1918-1944	13.8 %	21.5 %
1945-1970	29.4 %	36.1 %
1971-1989	42.5 %	28.2 %
After 1989	0.8 %	0.8 %

2.2 Forecast of Construction Industry Development to the year 2000

In the current period of transformation in the Polish construction market, forecasting industry development is complex. The Institute of Building Construction predicts that residential construction will develop as follows:

Table 5 Forecast of Residential Building Construction

Year	Number of buildings
1996	45.000
1998	60.000
2000	80.000

However, actual demand for new buildings is much higher. Actual demand to the year 2000 is presented in Table 6.

Table 6 Actual Demand for New Residential Buildings

Item	Specification	Number of apartments
1.	Present deficit	1.300.000
2.	Household growth	1.100.000
3.	Demolition of old apartments	1.000.000
	Total	3.400.000

Residential housing construction accounts for 50% of all cubature built in Poland. This share is expected to remain relatively constant. Other construction sectors– industrial, agriculture, commercial and public (municipal)– are expected to develop similarly.

2.3 Windows in Housing

An estimated 100.000.000 windows are installed in the existing stock of residential buildings. Most of these do not meet current standards for heat insulation.

The majority of the windows built before 1918, such as those installed in old houses in villages (i.e. small farm houses), have only one window pane. Village buildings are in very poor condition and modernization is not economically feasible.

Residential buildings constructed from 1918-1944 generally have framed windows or casement windows (also known as French windows). The former are windows with two frames, one frame opening outside and other inside, while the later are windows with two frames, both opening inside.

Framed windows were also used in rural buildings in later years, due their simple construction and very low cost. However, in urban areas, framed windows have been replaced by composite (or Swedish) windows, which use less wood. Composite windows are double-framed windows, in which the two frames are connected by special screws or clamps and open to the inside. Each frame has single-pane glazing with putty.

In the past few years, the popularity of single-framed windows (double or triple-glazed units) made of wood, PVC, or aluminum has increased. Because PVC and aluminum windows cost 1.5 times more than wooden windows, they are not yet used widely.

2.4 Windows In Use

Since 1990, about 30.000 state-owned buildings housing 500.000 apartments have undergone major repairs. Data on the number of buildings with updated windows and for the private sector are not available.

By the year 2000, major repairs that include replacement of windows will be necessary for an estimated:

- 60% of urban buildings built before 1918. (The remaining 40% of these buildings should be demolished.)
- 30% of urban buildings built from 1918-1944.
- 20% of urban buildings built from 1945-1970.

Those buildings not specified above will require major repairs after the

yApproximatelyAproximately 5,000,000 windows need to be replaced in the buildings listed

above. This equals more than 1,000,000 replacement windows per year through the year 2000 alone.

Rural buildings predating 1994 are not worth repairing. These buildings are wooden and gradually will be replaced. Nevertheless, an estimated 1,100,000 replacement windows per year will be necessary for rural buildings through the year 2000.

Due to higher capital expenditures after the year 2000, the demand for windows for residential buildings is expected to increase to 2,500,000 per year. Industrial needs will be about 500,000 windows annually.

3. TECHNICAL PARAMETERS

The building regulations outlined in the "Law on Housing" of October 24, 1974, state that only materials, products and technologies which meet Polish National Standards (Polskie Normy- PN) or Polish Branch Standards (Normy Bran owe- BN) can be used in domestic construction. The most important regulations are listed below:

- PN-91/B-02020 Heat insulation of buildings. Requirements and calculations.
- PN-87/B-02161/01,02, and 03 Architectural acoustics. Prevention of noise in buildings.

New materials and designs for which standards have not been determined may be allowed in construction after review by the Building Research Institute.

The physical parameters of windows are the most important factors which determine window utility, particularly in residential construction:

1. Air infiltration

In Polish residential construction, air infiltration is one of the basic sources for inflow of fresh air into apartments. According to regulation PN-91/B-02020, listed above, the coefficient of

air infiltration must be within the interval of 0,5 - 1 $m^3(m•h•daPa^{2/3})$.

2. Leakage prevention

Closed windows or doors prevent rain water infiltration. According to regulations, leakage prevention has to meet pressure differences of up to 16 daPa and water intensity equal to 120 $l/h•m^2$.

3. Heat insulation

Heat insulation is a key feature of windows. Evaluation of window utility for insulation is defined by the heat transfer coefficient, $W/(m^2•K)$, without air infiltration.

In terms of building regulations, Poland is divided into five climate zones with obligatory heat transfer coefficients as follow:

- Region I, II and III– $k<2.6\ W/(m^2•K)$
- Region IV and V– $k<2,0\ W/(m^2•K)$

4. Acoustic insulation

The ability to baffle outside noise is expressed by insulating indicators in dB. For residential buildings, depending upon window placement, these indicators are :

- for noise levels up to 60 dB - $R_{w\ min} = 25$ dB
- for noise levels from 61 dB to 65 dB- $R_{w\ min} = 30$ dB
- for noise levels from 66 dB to 70 dB- $R_{w\ min} = 35$ dB
- for noise levels over 70 dB - $R_{w\ min} > 35$ dB

Additionally, windows are characterized by mechanical features such as wind resistance, resilience of the frame structure in different surfaces, durability of frame joints and ferrule used.

4. WINDOW CONSTRUCTION AND MATERIALS

4.1 Wooden Window Production

Wooden window production in Poland in the eighties equaled about 9-10 mln m^2 yearly.

Rapid decrease (to 4 mln m^2) was caused by:

- Significant decreases in new residential housing construction, and
- Substitution of PVC and aluminum for wood .

Table 7 presents wooden window production from 1980-1994.

Table 7 Wooden Window Production in Poland, 1980-1994

years	1980	1985	1989	1990	1991	1992	1993	1994	1995
thousand m2	10.689	9.521	8.250	5.259	4.433	3.852	4.723	5.059	5.666
thousand of window units	6.287	5.600	4.853	3.094	2.608	2.266	2.788	2.976	3.333

** window unit - 1.7 m2*

According to short-term construction forecasts, wooden production will be as follows:

years	1996	1997	1998
thousand m2	6242	7100	8200
thousand of window units	3671	4176	5824

** window unit - 1.7 m2*

Until 1989, window production was based almost entirely on wood. Currently, only an estimated 42% of all windows are made of wood, while 35% are made of PVC and 23% of aluminum.

4.2 Certification requirements

Current regulations require wooden windows in the Polish market to have:

- Technical approval by the Building Research Institute (Instytut Techniki Budowlanej - ITB);
- Technical certification by the Building Research Institute (ITB);

- An evaluation of health impacts issued by the State Hygiene Department (Pañstwowy Zakład Higieny).

Technical approval certifies that the proposed system of windows and doors may be used in housing. This approval is issued primarily for foreign customers. Each certificate of technical approval shows the name of the customer and other information on certification requirements.

Technical certification permits the use of specific products in housing. All windows must pass physical, acoustic and strength testing. For technical certification, specialists from ITB visit the factory of origin to check the production process and inspection system. Every producer is required to undergo technical certification.

4.3 Window Panes

Double- and triple-glazed units are key elements of energy efficient window production Due to the increasing demand for energy efficient windows, a Polish glass factory began producing float-glass in 1990. A number of factories producing double- and triple-glazed units were also established at that time. The main exporters of window pane units are Belgium, Sweden and Italy.

The basic window packages that meet insulation standards are:

- Double-glazed unit – (4 x 12 x 4) or (4 x 16 x 4)
- Triple-glazed unit – (4 x 6 x 4 x 6 x 4)

The price for a double-glazed unit (4 x 12 x 4) is about 80 PLN.

4.4 Wooden Window Market

As mentioned earlier, an estimated 100.000.000 windows are housed in residential buildings, 95% of which are made of wood. Only 2% of windows in residential buildings are modern, single-framed windows. Most commonly, existing windows are low quality, produced from extremely low-grade wood. Significant renovation of low quality windows is needed to ensure leak tightness and heat insulation. Since renovation is complicated, requiring

dismantling of frames, additional seals, and painting, low grade windows are being replaced by single-framed wooden or PVC windows.

Several thousand manufacturers operate in the wooden window market. Many of these producers are small, private shops which make only some of the necessary elements. There are about 200 larger producers. An estimated 65% of all wooden windows are produced in 18 large factories. Among the largest is Stolbud-Wolomin, which produced 350,000 wooden windows (single-frame and composite) in 1994.

The most popular single-framed windows are made from either solid or laminated wood. These windows usually have sash/hopper window ferrule and double- or triple-glazed units.

Wooden frames require special treatment to increase their durability. The most common treatment technique is a surface impregnation method. None of the existing manufacturers use the more expensive– but more efficient technique– of deep impregnation (also known as double-vacuum). Ecologically-benign, water-based paints are commonly used.

4.4.1 Wooden Window Prices

Providing price data is difficult, because price is determined by the quality of the ferrule and opening system of each window. However, based on data from producers, the average prices for a sash/hopper window are shown below:

Table 8 Average Price for Wooden Windows in March 1997 (without 7% VAT) in PLN

		880 x 1450 mm	1480x1450 mm	880x2310 mm
1	Swedish window	185	213	251
2	Single-framed window from Stolbud	254	460	394
3	Single-framed from small producers	342	531	506
4	Single-framed with imported ferrule	625	1090	923

4.5 PVC Window Market

Over the past several years, plastics have been the most popular substitute for wood in window production. PVC has been the most common substitute both due to its technological features and low cost. Since 1991, the relative share of production of PVC windows has grown rapidly. Because of the low investment cost to establish a factory for assembly of PVC windows, a number of these factories have been set up. Recently, fiber glass windows have also appeared on the Polish market.

Ninety-nine percent of window factories assemble ready-made profiles. Unfortunately, these factories are often small manufacturers which produce poor quality windows using primitive machines. Generally, windows produced by these factories do not meet standards. However, the cost of these windows is low and they are able to compete successfully with better quality windows.

Only the largest Polish factories produce high quality windows that meet European standards. Thirty four factories export their products to Germany, which demonstrates the high quality of their products. Russia and the countries of the former Soviet Union are the second largest market for Polish windows.

At present, only 6 stamping presses for PVC profiles exist in Poland, covering 65% of domestic demand. The remaining profiles are imported from Western Europe, primarily Germany, Austria and Italy.

Table 9 lists each stamping press factory in Poland and the profiles produced.

Table 9 Stamping Press Factories in Poland

No.	Factory name and place	Profile
1	Zakłady Azotowe in Tarnów	Panorama PA 1000
2	Thermoplast Ltd. in Libi	Thermoplast, Accord
3	Erg-Profil Ltd. in Czelad	Poltrocal, Panorama
4	Zagra Ltd. in Bydgoszcz	Intertec
5	Montex Ltd. in Lublin	Montex
6	Veka Ltd. in Skierniewice	Veka
7	Rehau Ltd. in Poznañ	Rehau

The stamping technology and raw materials used to manufacture domestic products are comparable with imported profiles. High quality PVC is produced at a factory in Włocławek (Zakłady Azotowe). Other components are imported from Western Europe. Window profiles are made from granulated or powdered PVC, chalk ($CaC0_3$), titanium dioxide (TiO_2), impact strength modifiers, stabilizers and fluidity modifiers. The stabilizers currently used do not contain harmful compounds of cadmium and barium. Instead, lead stabilizers are used, which are expected to be replaced by calcium-zinc stabilizers.

About 70 important window manufacturers produce profiles for the following systems:

Aluplast	-	Germany	Schüco	-	Germany
Brügmann	-	Germany	Thermoplast	-	Poland
Deceunick	-	Belgium	Thyssen	-	Germany
Gealan	-	Austria	Trocal	-	Germany
Intertec	-	Austria	Veka	-	Germany
KBE	-	Germany			
Kniping	-	Germany			
Panorama	-	Poland			
Plastmo	-	Denmark			
Plus Plan	-	Germany			
Poltrocal	-	Poland			
Rehau	-	Germany			
Ropisto	-	Germany			

One of the cheapest systems, Panorama PA 1000, is the market leader. Two stamping factories in Poland produce this system.

PVC profiles account for an estimated 35% of total window production in Poland, an amount which has increased especially in the last few years

4.5.1 PVC Window Prices

The prices shown below are from catalogs listings dated 1.03.1996. The 7% VAT is not included. Average prices differ for each system. Even greater price differences appear among different manufacturers for the same profile system. Table 10 presents average prices for windows in different systems, and Table 11 provides the window prices for the same profile system made by different manufacturers.

Table 10 Average Prices for PVC Windows by System

Item.	System	S a s h / h o p p e r window 1450x880	S a s h / h o p p e r window 1450x1480	Balcony doors 2310x880
1	Aluplast	398	622	460
2	Brügman	448	858	631
3	Deceunick	539	914	780
4	Intertec	460	843	625
5	KBE	420	784	593
9	Panorama	357	614	487
10	Poltrocal	280	463	396
11	Plastmo	387	691	522
12	Rehau	483	890	728
13	Roplasto	434	779	680
14	Thermoplast	400	680	560
15	Trocal	433	731	688
16	Veka	431	765	613

Table 11 Prices for PVC Windows by System and Manufacturer

No.	Company	Sash/hopper window 1450x880	Sash/hopper window 1450x1480	Balcony doors 2310x880
PANORAMA				
1	Ofkens	323	561	434
2	Mostostal	347	606	462
3	Budomont	414	740	589
4	Stolbud W-wa	385	681	544
POLTROCAL				
1	Metalplast	295	400	411
2	Ofkens	244	419	338
3	Stolbud W-wa	315	537	440
INTERTEC				
1	Agrosoc	420	750	520
2	AP-¯ory	469	895	697
3	Weru-Vitton	510	900	712
VEKA				
1	M&S S³upsk	360	634	519
2	Linda	393	673	537
3	Filplast	520	942	828

Considering the high prices and low income of Polish citizens, window manufacturers must compensate for high prices by offering reliable services. Services offered include delivery, replacement of existing windows and ongoing maintenance. Window assembly prices range from 15 to 30 PLN per meter of window, while replacement of existing windows (disassembly and assembly) ranges from 25 to 35 PLN per meter.

All major companies have their own distribution networks. Additional services such as assembly roller blinds and window shutters are also offered. Smaller companies operate mainly in local markets.

4.6 Aluminum Window Market

As in Western European countries, aluminum windows are used in industrial and commercial

buildings. This is seen especially in modern buildings with large glass surfaces. Aluminum is currently the most expensive material in the Polish market.

Prices for PVC and aluminum windows are 20-50% and 120-150% higher, respectively, than prices for wooden windows. However, high quality wooden windows (only produced by special order) are at least as expensive and sometimes even more costly than aluminum windows.

As with PVC, aluminum window design reflects the influx of know-how from Western Europe. The systems available have either been introduced directly by German, French, Italian, Belgian, and Swedish companies or by their Polish partners.

At present, only two local companies produce aluminum profiles in Poland: Zakłady Stolarki Budowlanej in Kêty and SAPA Poland in Trzcianka. Both companies use Swedish aluminum.

Due to the Polish climate, “warm” aluminum profiles– with a special, thermic pad– are those most often used.

The most popular aluminum systems on the Polish market are:

Ekip Thermo	-	Belgium
Ekonal	-	Poland
Integral 80	-	Sweden
Hueck	-	Germany
Metalplast-Bielsko-		Poland
Reynaers	-	Belgium
Reynolds	-	Holland
Royal	-	Germany
Sapa	-	Sweden
Wicona 2000	-	Sweden

4.6.1 Aluminum Window Prices

Table 12 presents a comparison of prices for the aluminum windows made in different systems.

Table 12 Aluminum Window Price Comparison

No.	System	Sash/hopper window 1450x880	Sash/hopper window 1450x1480	Balcony door 2310x880
1	Alutherm	1315	2270	1625
2	Hueck	770	1179	1688
3	Integral	1074	1780	1598
4	Metalplast	800	1145	1115
5	Reynaers	1301	1745	1655
6	Reynolds	1341	1895	2216
7	Yawal	1083	1382	1484

This table shows that significant differences (up to 30%) exist among prices of aluminum systems. Aluminum windows are especially popular in the commercial sector for shop windows.

5. ENERGY EFFICIENT WINDOWS

5.1 Definition

In Poland, as in other European countries and the U.S, there is no strict definition of energy efficient windows with fixed parameters. However, as a general definition: **an energy efficient window should not only conform to basic requirements for safety and thermal comfort, but the use of such a window should improve the thermal balance of a building and be cost effective** (for instance short SPBT or positive value of NPV).

Economic approaches to determine the efficiency of windows are not useful in Poland due to non-economic prices for energy, materials and labour. A simplified analysis was performed in

July-August 1996, when new Technical Regulations were established for thermal insulation of buildings. This analysis showed greater economic efficiency for increasing the thickness of insulating materials, than lowering the *U*-value for windows. As a result, regulations requiring greater window insulation are being introduced gradually .

An additional concern is that, historically, windows– or more exactly the clearances between wings and frame– are part of the ventilation system. Although air-tight windows are desirable in terms of energy conservation, installation of such windows in Poland has led to mould growth problems.

Generally appropriate choice of windows should take into account:

- the building and its orientation,
- ventilation of compartments and air infiltration through windows,
- use of thermostatic valves to take advantage of gains in solar radiation.

No official document in Poland specifies criteria for evaluation of the energy efficiency of windows. Based on the existing official documents– Technical Requirements, Polish and European Standards, Recomendations of the Building Research Institute and Technical Approvals [1-15]– the criteria listed in Table 13 have been developed for evaluation of energy efficiency.

Table 13 Basic criteria for evaluation of the energy efficiency of windows

Requirements	Criteria of avaluation	Factors to be taken into consideration
1	2	3
Protection against excessive air infiltration through clearances and joints between windows and opaque envelopes	Air infiltration coefficient through windows a, $m^3/(m \times h \times \Delta p^{2/3})$ should not exceed maximum values	Wind load, depending upon wind load zone, building height and location. Mean air velocity in heating period
Protection against excessive heat losses	Annual energy requirements for heating of a building E, MJ/ $(m^3 \cdot a)$, less than limit value E_0. U-value less than maximum U-value	The structure of glazed and opaque parts of windows
Protection against water vapour condensation on internal surface of glazing and window frames and adjacent opaque envelopes	Temperature of internal surface higher than dew point. Permanent or intensive periodical condensation may not disturb the optical properties of glazing and causing the moulds growth on window frames and adjacent opaque envelopes.	The structure of windows and adjacent opaque envelope. The use of compartments and air parameters. Temperature of external air.
Protection against internal water vapour condensation between glazing and on window frames.	Permanent or intensive periodical condensation betwen glazing and on window frames not allowed.	The structure of windows, type of glazing and sealing of clearances.
Conformity with indoor air quality standards.	Necessary flow of air for ventilation.	Conformity w/ standards for ventilation air inlets and/or window clearances.
Protection against excessive solar radiation and overheating of rooms.	Maximum air temperature in rooms in summer time should not exceed predicted values.	Window/floor area ratio. Type of glazing. Solar screens. Use of air conditioning. Heat capacity of inner mass of a building.

Best window choice is dependent upon the HVAC System of a building. Therefore, the definition of an energy efficient window must allow for a range of technical possibilities. The existing requirements and foreseen changes are detailed below.

5.2 Overview of windows which satisfy energy efficiency needs

This overview is based on the experience of the authors gained during preparation of Technical Approvals.

The k-values of windows are determined by the Guarded Hot Box method or by computer

calculations performed using the programs FRAME or WAEBRU. Input data should be prepared according to CEN/TC 89 document N 478. Mean k-values of windows are calculated by taking into account the k_R-value of the frame, k_o-value of glazing and the ratio of areas.

Currently, window frames in Poland are produced from wood, PVC and aluminium.
The lowest k_R-value for wood frames does not usually exceed 1.7 W/(m².K).
The k_R-value for PVC window profiles depends upon form and external dimensions, as well as:

- number and dimensions of closed air cells in a frame,
- location of a window wing profile versus window sash,
- location of a glazing groove,
- form and location of metal reinfocing details.

The k_R-value for PVC window frames with at least 3 air cells does not exceed 1.7 W/(m².K); profiles with 2 air cells are worse.

The k_R-value for aluminium window frames with thermal break at least 20 mm thick is about 3.0 W/(m².K); the temperature of the inner surface will be much lower than for wood or PVC frames.

The k_o-value of glazing mostly depends on:

- glazing distance,
- type and concentration of gas in a closed gas space,
- type and location of low-emissivity coating.

Table 14 **Exemplary k_o-values for the middle part of glazing units depending upon type of glazing and gas, with concentration not less than 90 %**

Type of glazing	Type of glass and emissivity factor	k_0-value, W/(m².K)			
		Air	Argon	Krypton	SF_6
One cell 4/16/4	normal 0,9	2,7	2,6	2,6	3,1
	low-emiss. 0,4	2,2	2,2	2,2	2,7
	low-emiss. 0,05	1,5	1,2	1,1	2,2
Two cells 4/12/4/12/4	normal 0,9	1,9	1,8	1,6	2,0
	two panes with low-emiss. 0,4	1,5	1,3	1,1	1,6
	two panes with low-emiss. 0,05	1,0	0,8	0,5	1,1

5.3 Discussion

There is no strict definition of an energy efficient window with fixed parameters. However, if a window meets the requirements of Polish Technical Regulations with some surplus (eg. 20-30% lower *k*-value) or economic analysis shows the economic efficiency of use, such windows can be considered energy efficient.

As a first step one can use a *k*-value < 2.0 W/(m²×K). This condition is met by windows with wooden or other (with 3 cells per profile thickness) frames and three regular glass panes or

two panes with low emissivity coating.

The thermal properties of windows depend not only on type of frame and glazing, but also on the ratio of their area. Windows of the same profile type can have different thermal properties. Therefore, it is difficult to determine the share of energy efficient windows in the Polish market. Despite of wide range of profiles and glazing available, in practice, Polish consumers choose windows which are low cost or attractive. The share of energy efficient windows on the market is small and does not exceed 15 - 20 %. Because energy costs are still relatively low, energy efficiency is not a serious element in decision making.

As energy prices increase and free market mechanisms take hold, energy efficient products will be more important. However, freeing of the market requires highly unpopular political decisions.

6. FOREIGN COMPANIES IN THE POLISH MARKET

6.1 Legal Regulations

The basic legal regulations for foreign activities in Poland are the same as the regulations for Polish enterprises, as stated in the "Law of June 14, 1991 on Companies with Foreign Participation." According to that regulation, if a foreign firm wishes to do business Poland, it should establish a company, either separately or in cooperation with a Polish partner (i.e. a joint-venture). If a foreign company wishes to work with a state-owned enterprise, special permission must be granted by the Ministry of Ownership Transformation.

In order to establish a company, company statutes must be registered by a public notary. The fee to register a company with limited liability is 4.000 PLN and the cost of registering a joint stock company is 100.000 PLN. These documents of registration must be entered in a Court register. Following registration by a notary, the company must register in the Main Statistical

Office, the Fiscal Office, and the Social Insurance Office. Opening a bank account is the last step required.

Foreign companies do not require special permission to rent an office or industrial space. However, in order to purchase space or own property, foreign companies need to be granted special permission by the Ministry of Internal Affairs. Detailed regulations exist for different types of companies, locations, and property.

In general, the latest changes in regulations for companies with foreign capital make the laws more clear and understable. All regulations are the same for foreign and domestic owners.

6.2 Cooperation with Polish Partners

A number of enterprises would be interested in cooperation with foreign companies. Foreign companies should determine the degree of cooperation in which they are interested, from transfer of techical expertise to setting up licensing agreements to production. As mentioned in section 4.1, there are no legal barriers to such cooperation.

An assesment of interest by Polish window manufacturers in cooperation with foreign partners is dependent upon the type of cooperation intended by the foreign company. Proposals may best be addressed to small enterprises which experience technological and financial difficulties.

7. CONCLUSIONS

The data presented in this report show that large market potential exists for retrofitting windows in Poland, especially with use of PVC.

But, because income levels in the Poland are far below those of Western countries, consumers are less able to purchase expensive windows. Windows made of different materials exhibit different costs than in Western nations. Low quality, wooden windows still dominate the Polish window market. These windows are not manufactured by foreign companies. The PVC window is the least cost alternative produced by foreign companes. Still, PVC windows are much more expensive than wooden windows in Poland (see Section 6). If Polish consumers decide to buy PVC windows, these consumers will look for the cheapest PVC product available. Often, differences in quality are difficult to detect.

Many companies offer a large variety of profiles with similar characteristics in the Polish market. In order to introduce a new type of profile, producers must be able to make an attractive offer. In the short-term, price will remain the main motive in the decision making process.

8. SUPPORTING LITERATURE

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9. LIST OF REGULATIONS

Instrukcja nr 224/79 Wymagania techniczno - u ytkowe dla lekkich œcian osłonowych w budownictwie ogólnym. ITB Warszawa 1979,

Wymagania techniczno-u ytkowe i kryteria oceny przegród zewnêtrznych w zakresie wymagania podstawowego "oszczêdnoœæ energii i ochrona cieplna" - projekt nowelizacji instrukcji ITB nr 224.

Instrukcja nr 343 Nawiewniki powietrza zewnêtrznego do pomieszczeñ. ITB Warszawa 1996.

4. PN-91/B-02020. Ochrona cieplna budynków. Wymagania i zasady obliczeñ.

PN-77/B-02011. Obci enia w obliczeniach statycznych. Obci enie wiatrem.

ISO 8990 Thermal insulation - Determination of steady-state thermal transmission properties - Calibrated and guarded hot box

BN-75/7150-03. Okna i drzwi balkonowe drewniane. Metody badañ

EN-42/76. Methods of testing windows. Part 1. Air permeability test.

EN-86/80. Methods of testing windows. Part 2. Watertightness test under static pressure.

PN-83/B-03430 Wentylacja w budynkach mieszkalnych, zamieszkania zbiorowego i u yteczno œci publicznej. Wymagania.

Rozporz dzenie Ministra Gospodarki Przestrzennej i Budownictwa z dnia 14 grudnia 1994 r. w sprawie warunków technicznych, jakim powinny odpowiadaæ budynki i ich usytuowanie (Dz.U. nr 10 z 1995 r.)

BN-89/6821-02 Szkło budowlane. Szyby zespolone

PN-82/B-02402 Ogrzewnictwo. Temperatury ogrzewanych pomieszczeñ w budynkach

Dyrektywa Rady 89/106/EEC Wymaganie podstawowe 6.

PN-82/B-02403 Ogrzewnictwo. Temperatury obliczeniowe zewnêtrzne