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March 26, 2003

Mr. Richard H. Karney, Manager
Energy Star Program
Department of Energy
Office of Building Technologies Program
1000 Independence Avenue, SW
Washington, DC 20585

Subject: Energy Star 2003 Proposal

Dear Rich:

Consulting Collaborative serves building product manufacturers in the fenestration industry. We have domestic and international clients ranging in annual sales from $100 million to over $20 billion. They value my expertise and trust my opinions.

I wrote several letters addressing the Energy Star 2002 proposal. As a general comment, it is very concerning to note that nowhere in the Energy Star 2003 proposal does it acknowledge or recognize the serious concerns that were brought to DOE's attention by the aluminum fenestration industry applicable to the May 2002 proposal that was subsequently withdrawn.

With respect to the 2003 proposal I will just write one letter, albeit very lengthy because there is so much that needs to be said. As you will see, I'll be addressing more than just U-Factors, but in addition, surrounding facts that Energy Star needs to take into consideration which definitely impact your decision sooner or later.

My goal is to make sure the Department of Energy, the Energy Star Program and other related matters are unbiased, accurate, fair, and, most of all, beneficial to consumers in the long-term. I have many issues that concern me. I hope that you will be enlightened as well so that you do not proceed with a course of action that will ultimately prove ill-advised, embarrassing to DOE and a detriment to consumers. Additionally, I base my recommendations on your main goal of saving energy and, at the same time, make sure that products being purchased by consumers based upon Energy Star recommendations meet their needs in the long-term and protect the environment.

My list of topics is as follows:

Proposed Performance Criteria

Long-Term Durability of Windows

Environmental Impact

Life Safety

Strengths and Weaknesses of Materials

Alternative Performance Based Standards

Proposed Performance Criteria

Overview on U-Factors and Solar Heat Gain Coefficients (SHGC)

The proposed Energy Star North Climate Zone accepts any SHGC for both the Three Zone Climate and Four Zone Climate models. Totally disregarding SHGC in the North increases annual energy costs. There should be a more stringent maximum SHGC in the Energy Star South and South/Central Climate Zones and a minimum SHGC for the North Climate Zone. Typically, lower U-Factors have their greatest impact in northern climates where Heating Degree Days (HDD) dominate energy costs, but a minimum SHGC standard also increases energy savings. In Cooling Degree Days (CDD) climates a better balance between U-Factors and SHGC achieves the best energy savings. I will provide several alternatives based upon RESFEN calculations on the various Climate Zones.

Three Climate Zones

Three Climate Zones U-Factors

Zone	Current Energy Star	Proposed Energy Star
South	0.75	0.65
Central	0.75 & 0.40	0.40
North	0.35	0.35

Three Climate Zones SHGC

Zone	Current Energy Star	Proposed Energy Star
South	0.40	0.40
Central	0.40 & 0.55	0.40
North	Any	Any

South Climate Zone

Based upon RESFEN calculations, here is the impact of using various U-Factors and SHGC in South Climate Zone (Three Climate Zone Map):

City	ES 2002 0.75/0.40	ES 2003 0.65/0.40	Revised 0.65/0.35
Miami	$696.30	$698.69	$669.88
Lake Charles	$554.82	$545.25	$531.79
Jacksonville	$505.16	$497.50	$483.26

Notes:

RESFEN calculations based upon a typical 2000 sq. ft. house with 300 sq ft of window area (15% of floor area).

ES 2002 = Energy Star current standards

ES 2003 = Energy Star 2003 Proposal

Lake Charles, Louisiana

Revised = Voreis recommendation

It is my feeling that by recommending a U-Factor of 0.65 and a SHGC of 0.35 that the additional energy savings could offset the minor shortfall in energy savings in the Central Climate Zone.

Central Climate Zone

Based upon RESFEN calculations, here is the impact of using various U-Factors and SHGC in the Central Climate Zone (Three Climate Zone Map):

City	ES 2002 0.75/0.40	ES 2003 0.40/0.40	Revised 0.45/0.35
Phoenix	$798.38	$747.43	$732.76
Fort Worth	$591.47	$533.68	$532.63
Fresno	$493.11	$431.27	$434.00
Las Vegas	$668.49	$593.49	$595.69
Memphis	$704.58	$636.34	$637.89
Atlanta	$490.29	$428.83	$433.04

Notes:

RESFEN calculations based upon a typical 2000 sq. ft. house with 300 sq ft of window area (15% of floor area).

ES 2002 = Energy Star current standards

ES 2003 = Energy Star 2003 Proposal

Revised = Voreis recommendation

North Climate Zone

Based upon RESFEN calculations, here is the impact of using various U-Factors and SHGC in the North Climate Zone (Three Climate Zone Map):

City	0.35/0.25	Revised 0.42/0.50	0.40/0.40
Madison, WI	$791.17	$790.32	$795.26
Seattle	$469.69	$446.83	$456.35
Boston	$674.36	$665.38	$671.40
Buffalo	$754.78	$760.17	$750.59

Notes:

RESFEN calculations based upon a typical 2000 sq. ft. house with 300 sq ft of window area (15% of floor area).

No SHGC was recommended by Energy Star in current standards or new proposal

Revised = Voreis recommendation

Four Climate Zones

Four Climate Zones U-Factors

Zone	Current Energy Star	Proposed Energy Star
South	0.75	0.65
South/Central	0.75	0.40
North/Central	0.40	0.40
North	0.35	0.35

Four Climate Zones SHGC

Zone	Current Energy Star	Proposed Energy Star
South	0.40	0.40
South/Central	0.40	0.40
North/Central	0.55	0.55
North	Any	Any

South Climate Zone

Based upon RESFEN calculations, here is the impact of using various U-Factors and SHGC in South Climate Zone (Four Climate Zone Map):

City	ES 2002 0.75/0.40	ES 2003 0.65/0.40	Revised 0.65/0.35
Miami	$696.30	$698.69	$669.88
Lake Charles	$554.82	$545.25	$531.79
Jacksonville	$505.16	$497.50	$483.26

Notes:

RESFEN calculations based upon a typical 2000 sq. ft. house with 300 sq ft of window area (15% of floor area).

ES 2002 = Energy Star current standards

ES 2003 = Energy Star 2003 Proposal

Lake Charles, Louisiana

Revised = Voreis recommendation

It is my feeling that by recommending a U-Factor of 0.65 and a SHGC of 0.35 that the additional energy savings could offset the minor shortfall in energy savings in the South/Central Climate Zone.

South/Central Climate Zone

Based upon RESFEN calculations, here is the impact of using various U-Factors and SHGC in the South/Central Climate Zone (Four Climate Zone Map):

City	ES 2002 0.75/0.40	ES 2003 0.40/0.40	Revised 0.45/0.35
Phoenix	$798.38	$747.43	$732.76
Fort Worth	$591.47	$533.68	$532.63
Fresno	$493.11	$431.27	$434.00
Las Vegas	$668.49	$593.49	$595.69
Memphis	$704.58	$636.34	$637.89
Atlanta	$490.29	$428.83	$433.04

Notes:

RESFEN calculations based upon a typical 2000 sq. ft. house with 300 sq ft of window area (15% of floor area).

ES 2002 = Energy Star current standards

ES 2003 = Energy Star 2003 Proposal

Revised = Voreis recommendation

North/Central Climate Zone

Based upon RESFEN calculations, here is the impact of using various U-Factors and SHGC in the North/Central Climate Zone (Four Climate Zone Map):

City	ES 2002 ES 2003 0.40/0.55	Revised 0.45/0.35
Albuquerque	$427.49	$450.33
Memphis	$665.23	$637.89
Kansas City	$708.11	$708.11
Washington, DC	$590.31	$606.15

Notes:

RESFEN calculations based upon a typical 2000 sq. ft. house with 300 sq ft of window area (15% of floor area).

ES 2002 and ES 2003 are the same standard

Revised = Voreis recommendation

In my opinion, the wide variations in U-Factors and SHGC necessary to maximize energy savings for city-to-city seem to indicate that this climate zone should not exist. In other words, the Three Zone Climate Map is my preferred choice among the two options presented by Energy Star based upon the acceptance of my revised U-Factors and SHGC.

North Climate Zone

Based upon RESFEN calculations, here is the impact of using various U-Factors and SHGC in the North Climate Zone (Four Climate Zone Map):

City	0.35/0.25	Revised 0.42/0.50	0.40/0.40
Madison, WI	$791.17	$790.32	$795.26
Seattle	$469.69	$446.83	$456.35
Boston	$674.36	$665.38	$671.40
Buffalo	$754.78	$760.17	$750.59

Notes:

RESFEN calculations based upon a typical 2000 sq. ft. house with 300 sq ft of window area (15% of floor area).

No SHGC was recommended by Energy Star in current standards or new proposal

Revised = Voreis recommendation

Impact on U.S. Economy and Aluminum Window Industry

By my count, adopting the Energy Star 2003 proposal eliminates over 1,600 aluminum window products from the NFRC Directory and eliminates about 50 aluminum window manufacturers. The Energy Star 2003 proposal will eliminate thousands of jobs. This will have a very significant and negative impact on the economy in states where aluminum manufacturers and their suppliers have been in business for decades. In my opinion, this is restraining trade and forcing fewer choices on consumers who also must then endure life safety, environmental and long-term durability concerns that are inherent with vinyl windows.

It should be pointed out that aluminum windows can meet the Energy Star 2003 proposal of saving the same amount of energy, but instead, a different combination of U-Factors and SHGC must be used. As you have seen in my previous comments, the following U-Factor and SHGC have essentially the same energy savings results:

Three Climate Zones

Climate Zone	Energy Star 2003 Aluminum Windows Out	Proposed Alternatives Aluminum Windows OK
South	OK	0.65/0.35
Central	0.40/0.40	0.45/0.35
North	0.35/any	0.42/0.50

Four Climate Zones

South	OK	0.65/0.35
South/Central	0.40/0.40	0.45/0.35
North/Central	0.40/0.55	0.45/0.35
North	0.35/any	0.42/0.50

Notes:

Out = Out of business

OK = Still in business

There are serious long-term consequences for DOE and Energy Star as well. **By DOE essentially forcing aluminum window companies out of business now, as does the latest Energy Star 2003 proposal, it will make it impossible for the DOE to respond to future findings where vinyl will surely be proven to have serious environmental and performance flaws. Aluminum window manufacturers will no longer exist as the viable alternative in other areas of the country expect for Florida and the extreme southern portions of Texas, Louisiana, Mississippi, Alabama and Georgia.** I will now comment on these serious concerns applicable to vinyl windows.

Long-Term Durability of Windows

My research and professional experience in the fenestration industry has shown that aluminum is vastly superior to vinyl and wood materials in long-term durability.

In that regard, I have learned the Canadian Building Envelope Science and Technology (CAN-BEST) conducted a study of aluminum and vinyl windows a

few years ago. CAN-BEST is an independent professional engineering, laboratory testing, research and field investigating company.

The report presents the results of durability evaluation of aluminum and PVC (vinyl) windows subjected to cycling of pressure and exterior ambient and surface temperatures. Three window types of each material (total of six windows) were tested:

Vertical Slider (aka single/double hung window) @ 39.4" X 63.0"

Horizontal Slider (aka sliding window) @ 63.0" X 39.4"

Casement @ 27.5" X 63.0"

Notes:

Aluminum windows had crimped in place rigid extruded PVC "crucifix" thermal breaks (frame and sash).

PVC windows were non-reinforced PVC, thermally welded mitered corners (frame and sash).

The evaluation process comprised of monitoring the rate of air infiltration through the test windows while being subjected to cycling of pressure and temperature for a period of 29 days. During cycling, comparative air measurements were carried out on all windows at 1.57 psf pressure differential. In addition, the overall effect of cycling on window performance with respect to its ease of operation and air tightness was determined by testing in accordance with CAN/CSA A440-M90 prior to and following the cycling.

The rate of air infiltration in an operable or fixed window product is a key performance measurement used in the window industry for several decades. See AAMA testing procedures for reference documents. The more air infiltration allowed through the window, the lower the performance level of the window assembly and the less comfortable for the home or building occupants. In other words, heat loss and gain occur by infiltration through cracks in the window assembly.

Pressure Cycling

Pressure cycling was carried out between 0 to – 31 psf (equivalent to C1 window rating) continuously at the rate of one cycle per minute (average of 1,440 cycles per day) for the entire duration of temperature cycling.

Temperature Cycling

Temperature cycling was performed in according to existing ASTM standards. The procedure was modified to accommodate the superimposed pressure cycling, whereby the specified exterior ambient low temperature of –30º C was raised to -26º C during cycling due to the increased cooling load imposed by the simultaneous pressure cycling of windows.

Ambient temperature cycling, between -26º C and 50º C (-15º F and 122º F) was carried out at a rate of four cycles per day for 29 days. Surface temperature cycling between 21º C and 70º C (70º F and 158º F) measured on a black surface was carried out, in phase with ambient temperature cycling, at a rate of four cycles per day.

Test Results

The aluminum windows passed the test performance criteria.

The PVC windows had an increase in air leakage at a rate much higher than the aluminum windows. Following 29 days of cycling, the PVC windows met the ease of operation performance requirement. However, the windows failed to meet the minimum air tightness performance level of the CAN/CSA A440-M90 window standard. The air tightness rating fell below the minimum residential standards on the 19th day of cycling for both the vertical and horizontal sliders and on the 27th day for the casement window.

Test Limitations

By using Canadian testing standards rather than United States testing standards this does not offer input that we would normally consider here for evaluation purposes. In my opinion, testing should be conducted again using AAMA test standards and AAMA window classifications. It is my understanding that NFRC/AAMA are currently conducting testing called the NFRC Environmental & Ergonomic Exposure Testing Program, which has very similar test criteria to what was used by CAN-BEST. I believe the results will be the same as the findings in the CAN-BEST testing.

The crimped in place rigid extruded PVC “crucifix” thermal breaks for aluminum windows are no longer contemporary in the United States. As a matter of fact, this type of thermal break was almost exclusively used in Canada with very little use in the United States. Testing should be conducted again using a urethane pour and debridge thermal break design that is widely used today in the architectural aluminum industry. Again, the NFRC/AAMA testing that is currently underway is using aluminum windows with urethane pour and debridge thermal breaks.

Additionally, with increased air infiltration should also come increased water infiltration. High air and water infiltration are very serious deficiencies for windows leading to less than acceptable comfort for inhabitants and motivate window replacement in much shorter periods of time! Said another way, air infiltration wastes energy and also causes more energy to be used in the manufacturing process of the new windows that will be used to replace the inferior windows. Plus, the home owner must spend additional money for replacing the inferior windows.

On a related manner, the new Energy Star proposal eliminates aluminum windows in many Sunbelt states where very high ambient temperatures prevail in states like Arizona, California, Texas and New Mexico. This will compound the durability and air infiltration issues that I've outlined above. It is my experience that vinyl will deteriorate much more quickly and more severely in these hot climates.

Environmental Impact

The EPA, state and federal government agencies are concerned about the environment with respect to pending clean air and clean water legislation. Consumers and I also share these concerns.

In that regard, I have conducted research and have done extensive reading of publications that address detrimental impacts to our environment. One such area of major concern is the serious detrimental impact of vinyl (aka PVC) on the environment of the United States and the world community. I will share my findings with you.

Vinyl (aka PVC) is the second most commonly used plastic in the world and the most problematic for the environment.

Of all plastics, PVC is the most environmentally damaging through its entire lifecycle from production to disposal.

In the production of PVC it has been discovered that dioxins (highly toxic agents dangerous to humans and animals) were generated in the process of manufacturing. Additionally, numerous additives as softeners, heavy metals and fungicides are incorporated into the PVC involving a huge secondary toxic manufacturing industry.

PVC also presents a hazard to consumers in that plasticizers are not bound to the plastic and can leach out over time into the interior and exterior environments.

The disposal of PVC creates more environmental problems. If burned, either in an open fire or by incineration, PVC will release an acid gas along with dioxins

because of the chlorine content. The PVC industry has suggested incineration as a viable alternative, but the proposed energy recovery generates less energy from burning the plastic than was used to make it. Moreover, incineration generates dioxins and other toxic compounds in both air emissions and solid waste residues.

In landfills, it releases additives, which can threaten groundwater supplies as well as landfill fires involving PVC are a further source of dioxin.

Recycling is neither technically nor financially feasible; therefore, PVC recycling in the main consuming regions of the world amounts to less than one percent of consumption (Germany less than 1%, the Netherlands 1.5%, Spain less than 1% and less than 1% in the United States). To produce high quality products from recycled PVC requires that virgin PVC be added in very large quantities to form the new material. In the truest sense, this is not recycling. A 100% recycled PVC product has lower quality with little market value and spreads toxic additives into new areas of the world (mostly third world countries accept vinyl for recycling).

Worldwide PVC is coming under attack by government agencies because of its detrimental impact on the environment. In fact, a large number of communities have completed successful efforts to eliminate PVC from building product applications. For instance, over 200 communities in Europe including major cities is Austria, the Netherlands, Germany, Sweden, Luxembourg, Denmark and Norway have policies to restrict or avoid the use of PVC in public building construction and some have successfully built major new buildings without the use of PVC materials. Moreover, local communities, health groups, consumer organizations and industry associations have been calling for the European Union to phase out PVC.

In tracing the origins of PVC in building products, this material had its first major impact in Europe. As an example, PVC windows captured much of aluminum's market share over the past two decades, but more recently aluminum is making a resurgence because it has been shown that PVC windows have a damaging impact on the environment and that the overall performance characteristics of aluminum are superior to PVC in many ways.

For virtually all PVC applications, safer alternative materials exist. With respect to windows, entrances, storefronts, window walls, skylights and curtain walls aluminum is the safest material of choice with respect to its impact on the environment, its recyclability and overall performance which represents the best value to home and building owners. In many product applications, wood is also a viable material.

I believe that is it safe to predict that vinyl (PVC) as a building products material will eventually follow the same fate as what has happened in Europe. For the

Energy Star Program to knowingly recommend the use of vinyl windows with their inherent negative environmental impacts along with the fact of life that only about 1% of the material can be recycled is a disservice to the consuming public. Said another way, for the Energy Star Program to limit and even exclude aluminum windows from the vast majority of the geography in the United States demonstrates a lack of moral and ethical responsibility to the consumers in this country.

The US Green Building Council (USGBC), the organization developing standards for green buildings, is actively considering a proposal to give credit under LEED (Leadership in Energy and Environment Design) for the exclusion or minimization of PVC (aka vinyl) products from LEED accredited buildings. This proposal is being considered by a newly formed PVC taskforce under the USGBC Technical and Scientific Advisory Committee.

If adopted this proposal could be very detrimental to vinyl fenestration products. Although the current proposal focuses on non-residential buildings, USGBC is also developing a standard for residential buildings.

The USGBC has already made a major impact in Federal buildings since GSA has adopted the USGBC standards, which are committed to green buildings.

Interestingly, aluminum is actually an “energy bank” in that the original energy can be recovered through recycling time after time. In fact, annually of the aluminum consumed in the U.S., 30% of it comes from recycled aluminum. Aluminum has been used for over 116 years in this country and 66% of it is still in use because of repeated and cost effective recycling.

I recommend that the DOE and EPA authorize and fund an in-depth research study into the harmful impact of vinyl (PVC) to our environment. Until these findings are available, standards should not be established to eliminate or restrict the use of aluminum windows in any part of the country.

Life Safety Window Concerns

Apparently DOE is not informed on the Florida Dade County Building Code which mandates strict hurricane performance criteria for fenestration products for much of that state. These same building code requirements are migrating to other Gulf States as well as the states along the U.S. Atlanta Ocean coastline.

The new U-Factor being proposed by Energy Star eliminates the use of aluminum windows that meet hurricane building codes in about 95% of the geography that I outlined above. Conventional vinyl windows do not have the structural integrity to meet these hurricane building codes and, thus, the Energy Star proposed changes are endangering the life and safety of the population that resides in the following states:

Florida
Alabama
Mississippi
Louisiana
Texas
Georgia
South Carolina
North Carolina
Virginia

Other considerations that must also be addressed by Energy Star are where the structural integrity of aluminum windows is important as a life safety resistant to tornados, strong thunder storms, hail and high straight-line winds which prevail during various seasons of the year. Many south central inland states such as Oklahoma, Missouri, Nebraska, Arkansas, Tennessee, etc. need protection for life safety reasons. The proposed Energy Star 0.40 U-Factor in the Central Climate Zone essentially eliminates the use of aluminum windows in this geography. Most definitely, only triple glazed thermally broken aluminum windows can meet the U-Factor, but would not be price competitive with vinyl windows. As I have recommended, using a 0.45 U-Factor and 0.35 SHGC saves the proposed amount of energy, but does not eliminate aluminum windows in that geography.

Strengths & Weaknesses of Aluminum vs. Vinyl Windows

The Energy Star Program and NFRC have followed a course of action that has been a subtle and not so subtle "steering" of their performance standards to favor vinyl window manufacturers. As could be expected, there has been a preoccupation concerning only aluminum's U-Factor performance. Additionally, Energy Star has also been too focused and preoccupied with U-Factors that favor heating costs and disregard cooling costs, which is especially important in the South and South/Central Climate Zones of the United States. As I have shown, a minimum SHGC for the North Climate Zone also saves energy.

As you will see, clearly aluminum has a long list of strengths and basically only one relative weakness. As compared to vinyl, aluminum dominates the Top-10 performance criteria for fenestration products.

Strengths	Weaknesses
Structural Performance	U-Factor Performance
SHGC Performance	
Acoustical Performance	

Durability Performance

Air Leakage Performance

Water Leakage Performance

Expansion and Contraction Performance

Recycling Performance

Long-Term Value Performance

I can elaborate on the above strengths of aluminum with respect to narratives explaining each strength. Please contact me if you would like this additional information.

If performance standards take into consideration the overall strengths of aluminum instead of focusing almost entirely on U-Factor performance, then aluminum is much more acceptable to consumers, building owners, etc. The Energy Star Program needs to focus on "total performance" of aluminum and vinyl materials in fenestration products.

Unlike aluminum, vinyl is plagued by many weaknesses when "total performance" is taken into consideration. The following summary covering vinyl compared to aluminum speaks for itself.

Strengths	Weaknesses
U-Factor Performance	Structural Performance
SHGC Performance	Acoustical Performance
	Durability Performance
	Air Leakage Performance
	Water Leakage Performance
	Expansion and Contraction
	Recycling Performance
	Long-Term Value Performance

I can elaborate on the above weaknesses of vinyl with respect to narratives explaining each weakness. Please contact me if you would like this additional information.

To avoid their inherent weaknesses, vinyl window manufacturers have focused the Energy Star Program, NFRC, other building code authorities and consumers on their strength of U-Factor performance. This classic marketing ploy has resulted in what prevails in the Energy Star Program today and in the proposed changes to the Energy Star Program.

Alternative Performance Based Standards

Prior to this point, I have been recommending balancing the U-Factors and SHGC so that aluminum windows will survive in the United States while, at the same time, meet the energy saving goals of Energy Star. Essentially, what I am recommending is a "performance based standard" whereby aluminum or any other window frame material meets or exceeds Energy Star's performance standards. For example, in the Central Climate Zone if a vinyl window can do it with a 0.40/0.40 and an aluminum window with a 0.45/0.35 (U-Factor/SHGC) and both save the amount of energy deemed important to Energy Star, then it should not matter how the products produce the desired results.

Thus, as a completely different alternative, do not set U-Factor and SHGC limits as design criteria, but instead, establish a performance based standard for all products to meet or exceed.

The British Government has sponsored and published Document L whereby a separate set of material standards has been established for aluminum and vinyl windows. Document L is issued by the Secretary of State of the British Government and deals with conservation of fossil fuels as well as all aspects of building construction including heating equipment, insulation, flooring, walls, windows and anything to do with energy conservation. Hopefully, DOE and Energy Star are familiar with this document and its performance requirements for fenestration products. As another alternative, consideration should also be given to what has been adopted by the British Government.

In summary, the Energy Star Program needs to broaden and balance their perspective to include the important total performance criteria for windows as follows:

- Thermal Performance
- Solar Heat Gain
- Long-Term Durability

- Air and Water Infiltration
- Structural Strength
- Environmental Impact

In conclusion, I recommend that you withdraw or revise the Energy Star 2003 proposed design criteria with instead a more balanced performance criteria which recognizes that various combinations of U-Factors and SHGC can each meet the DOE's energy efficiency goals. Alternatively, establish a new performance based standard instead of the existing and proposed design based standard.

I appreciate being given the opportunity by DOE to review and comment on the proposed changes to the Energy Star Program. Please feel free to contact me with any questions and if you need clarifications or additional information.

Sincerely,

Richard D. Voreis

Richard D. Voreis
Chief Executive Officer

PS: I am in complete support of the recommendations and comments being made by the Aluminum Extruders Council.