Energy and Sustainability Topics – Site Energy Review

TANGRAM TECHNOLOGY Consulting Engineers

Tangram Technology Ltd.

33 Gaping Lane, Hitchin, Herts., SG5 2DF

Phone: 01462 437 686

E-mail: sales@tangram.co.uk

Web Pages: www.tangram.co.uk

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Energy and Sustainability Topics – Site Energy Review

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Part 1: Introduction

1. The Site Energy Review

The Site Energy Review (SER) is a diagnostic self-assessment tool developed to help plastics processing sites to:

- Assess their current energy management status.
- Provide a road-map for future work and improvements in Energy Management at a site.

It is not strictly suitable for use at a corporate level because of the focus on site performance but can provide some useful guidance in developing a Corporate Energy Strategy.

The SER generates a series of radar charts to allow a site to assess where it is in sustainability management terms. The SER is not designed to be a criticism of site activities but to provide a simple method of assessing status and progress.

2. Completing the SER

The SER is based on the contents of a book, 'Energy Management in Plastics Processing' by Robin Kent, published by the Elsevier (ISBN 978-0081025079).

This provides a structured approach to energy management for plastics processors and covers all the main topics of relevance at a plastics processing site. It is a practical workbook designed for use by plastics processors around the world and not as an academic textbook.

The SER is based on the framework used in the book and uses the structure of the book to assess energy management. This means that some of terms and words used in the SER may not be totally familiar unless the user has read the book. If you are not familiar with a specific term then reference to the book should make it clearer.

This document allows the user to print the document and complete the SER in hard copy and transfer the results to the radar chart for each topic.

3. The self-assessment sheets

Each self-assessment sheet covers a single issue.

Simply select the most appropriate description of the current site status and fill in the 0 to 4 rating in the score area. The results can then be transferred to the radar chart for assessment.

It is recognised that in many cases the site will not meet the exact description given – simply select the most appropriate score for the site even if it varies slightly from the description given.

In general, unless the site meets all of the statements in the box then the next lower box should be selected.

Continue this process until all the relevant self-assessment sheets are completed.

Note: It is recommended that the SER is completed by a group through discussion.

4. What to do if the topic is not relevant to the site

The SER covers a broad range of energy topics and some of topics in the Technical Issues section may not be relevant to all sites. If a topic is not relevant to your site, then feel free not to complete the particular topic. All topics in the 'Basics' section should be completed.

5. Example of using the SER

The SER is designed to provide not only an assessment of the current status of the site but also to signpost possible future actions to improve the status.

For example, in the 'Energy Policy' section for the 'Basics – Energy management' Sheet for the options are:

Level	Operational
4	Energy policy, action plan & regular review have commitment of top management as part of an environmental strategy.
3	Formal energy policy, but no active commitment from top management.
2	Unadopted energy policy set by energy manager or senior departmental manager.
1	An unwritten set of guidelines.
0	No explicit policy.
Score	

If the most appropriate current description is: 'No explicit policy.' then the score is 0 but the site can see the next set of recommended actions to improve the score.

This highlights areas for potential improvement and the SER can serve as a road-map for future actions.

6. Feedback

It is hoped that the SER will provide valuable information to companies on both their current status and actions for the future. If you have suggestions for improvements then please send these to the address on the front cover. We hope to further improve the SER to support sustainability management in the plastics processing industry.

Part 2: Basics

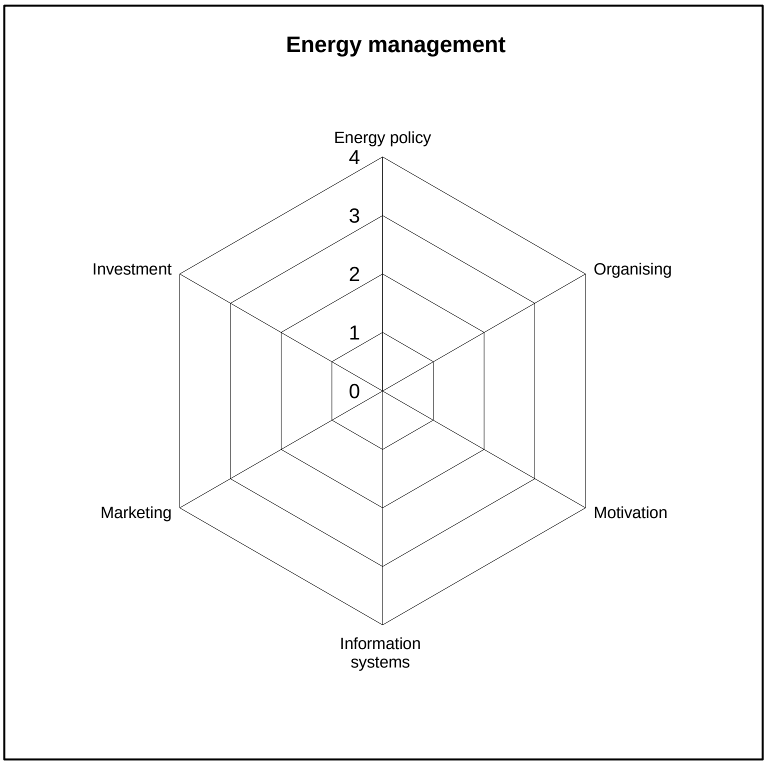
1. Energy management

Where are we starting from?

Understanding the current situation provides the basis for an improvement strategy and many of the basic actions necessary for successful implementation.

Sites need to get the basics in place to successfully implement energy management. This is no different to any other management programme, The basics must be in place before starting the programme to guarantee successful implementation.

Scoring



Basics - Energy management							2.1
Level	**Energy policy**	**Organising**	**Motivation**	**Information systems**	**Marketing**	**Investment**	
4	Energy policy, action plan & regular review have commitment of top management as part of an environmental strategy.	Energy management fully integrated into management structure. Clear delegation of responsibility for energy consumption.	Formal & informal channels of communication regularly exploited by energy manager & energy staff at all levels.	Comprehensive systems set targets, monitor consumption, identify faults, quantify savings & provides budget tracking.	Marketing of energy efficiency & energy management performance both internally & externally.	Positive discrimination in favour of 'green' schemes with detailed investment appraisal of all opportunities.	
3	Formal energy policy, but no active commitment from top management.	Energy manager accountable to energy committee representing all users, chaired by a member of the managing board.	Energy committee used as main channel together with direct contact with major users.	Monitoring & targeting reports for individual premises are based on sub-metering, but savings not reported effectively to users.	Programme of staff awareness & regular publicity campaigns.	Same payback criteria employed as for all other investment.	
2	Unadopted energy policy set by energy manager or senior departmental manager.	Energy manager in post, reporting to ad-hoc committee, but line management & authority are unclear.	Contact with major users through ad-hoc committee chaired by senior departmental manager.	Monitoring & targeting reports based on supply meter data. Energy unit has ad hoc involvement in budget setting.	Some ad-hoc staff awareness training.	Investment using short-term payback criteria only.	
1	An unwritten set of guidelines.	Energy management is the part-time responsibility of someone with limited authority or influence.	Informal contacts between engineering staff & a few users.	Cost reporting based on invoice detail. Engineer compiles reports for internal use within technical department.	Informal contacts used to promote energy efficiency.	Only low-cost measures taken.	
0	No explicit policy.	No energy management or any formal delegation of responsibility for energy consumption.	No contact with users.	No information system. No accounting for energy consumption.	No promotion of energy efficiency.	No investment in increasing energy efficiency.	
Score							

2. Financial management

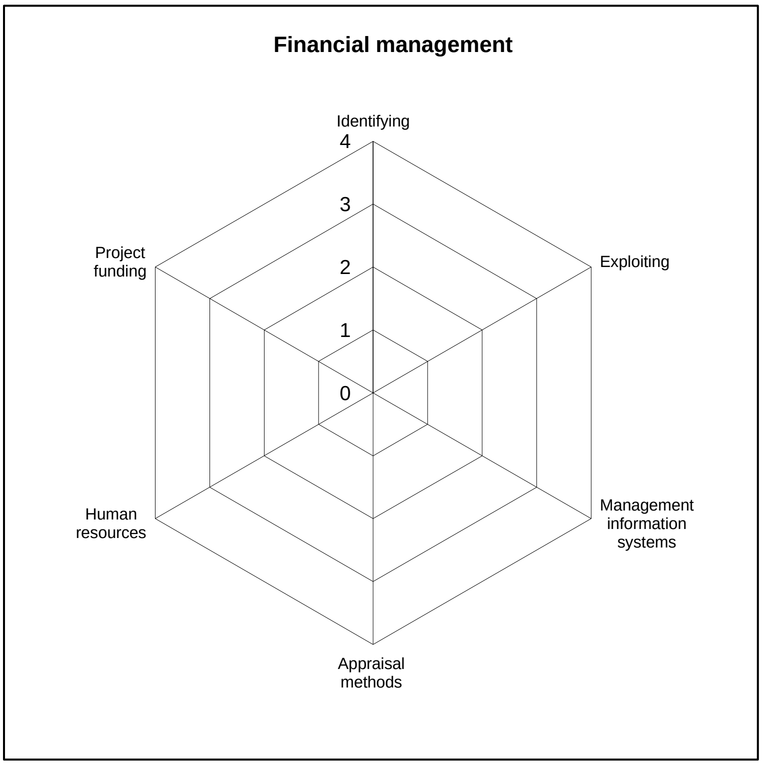
Without money it won't happen

Energy management is the same as any other project or process – starve the process of the appropriate investment and it will fail. All projects, even nominally no-cost and low-cost projects need investment in staff time and much progress can be made in these areas.

Eventually, the process will require financial investment of some magnitude and this must be justified before progress can be made.

Energy management does not require preferential funding. Most energy management projects can easily meet the standard investment hurdles and analysis that are in place at most sites. The main concern is that energy management receives the appropriate level of funding for the benefits that it can deliver.

Scoring



Basics - Financial management						2.2
Level	Identifying	Exploiting	Management information systems	Appraisal methods	Human resources	Project funding
4	Detailed energy surveys regularly updated. Lists available of opportunities already costed & ready to proceed.	Formal requirement to identify the most energy-efficient option. Decisions made on the basis of life cycle costs.	Full MIS enabling identification of past savings & further opportunities for investment meeting organisation's financial parameters.	Full discounting methods using internal rate of return & ranking priority projects as part of an ongoing investment strategy.	Board take a proactive approach to long-term investment as part of a detailed environmental strategy in full support of the energy team.	Projects compete equally w ith other areas. Full account taken of indirect benefits, e.g., marketing opportunities, environmental factors.
3	Energy surveys conducted by experienced staff or consultants likely to yield largest savings.	Energy staff are required to comment on all projects. Energy efficiency options often approved but no account is taken of life cycle costs.	Promising proposals are presented to decision-makers but insufficient information (e.g., sensitivity or risk analysis) results in delays or rejections.	Discounting methods using organisation's specified discount rates.	Energy manager w orking w ell w ith accounts/finance department to present w ell-argued cases to decision makers.	Projects compete for capital along w ith other business opportunities, but have to meet more stringent requirements for return on investment.
2	Regular energy monitoring / analysis used to identify possible areas for saving.	Energy staff notified of all proposals that affect energy usage. Proposals for energy savings are at risk w hen capital costs are reduced.	Adequate management information available, but not in the correct format or easily accessed in support of energy saving proposals.	Undiscounted appraisal methods e.g. gross return on capital.	Occasional proposals to decision makers by energy managers w ith limited success & only marginal interest from decision makers.	Energy projects not formally considered for funding from capital budget, except w hen very short-term returns are evident.
1	Informal ad-hoc energy w alkabouts conducted by staff w ith checklists to identify energy saving measures.	Energy staff use informal contacts to identify projects w here energy efficiency can be improved at marginal cost.	Insufficient information to demonstrate w hether previous investment in energy efficiency has been w orthw hile.	Simple payback criteria are applied. No account taken of lifetime of the investment.	Responsibility unclear & those involved lack time, expertise & resources to identify projects & prepare proposals.	Funding only available from revenue on low risk projects w ith paybacks of less than one year.
0	No mechanism or resources to identify energy-saving opportunities.	Energy efficiency not considered in new-build, refurbishment or plant replacement decisions.	Little or no information available to develop a case for funding.	No method used irrespective of the attractiveness of a project.	No-one in organisation promoting investment in energy efficiency.	No funding available for energy projects. No funding in the past.
Score						

3. Technical management

The plant is the thing

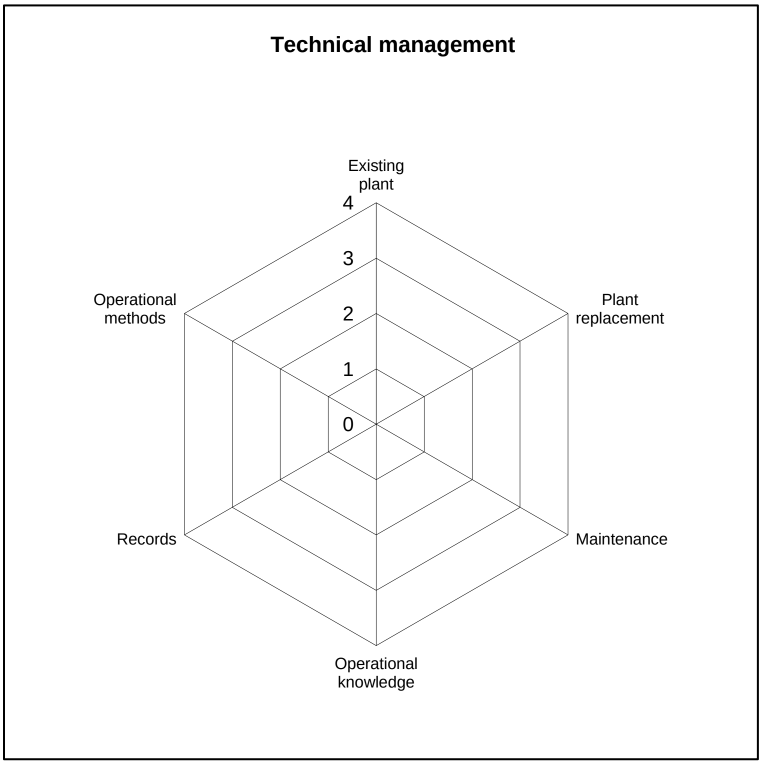
The distribution of energy use in plastics processing is very different to that in an office and many ‘buildings’ energy people do not understand this. The major energy users are the services and the plastics processing machinery and this is where the efforts must be concentrated.

This requires good technical knowledge of the processes used and good technical management of the process itself.

This chart tries to provide an assessment of these technical aspects of energy management.

Even when the majority of the operational plant was not originally designed with energy efficiency in mind there are many simple actions that can be taken to improve the energy efficiency of existing plant. These range from good maintenance actions, where simple low-cost tasks, such as the alignment of motor drives, can easily reduce energy use for existing plant through to involving the operators to reduce energy use.

Scoring



Basics - Technical management						2.3
Level	**Existing plant**	**Plant replacement**	**Maintenance**	**Operational knowledge**	**Records**	**Operational methods**
4	Majority of existing equipment uses best practice energy-efficient features, is correctly commissioned & well maintained.	Equipment chosen is the most appropriate for application. Life cycle costs & energy efficiency are major factors in selection.	Maintenance is based on needs, with condition appraisal used for all equipment & fabric elements affecting energy efficiency. Results acted upon.	Staff know how their actions affect energy efficiency & take positive steps to minimise energy use. Staff have targeted training in energy issues.	Detailed descriptions of systems, plant control & operation. Detailed schedules of all plant, instrumentation & controls.	Targets set by actual production volumes using historical performance. Monitored for actual usage by production area.
3	Equipment & plant is appropriately selected, energy efficient, commissioned for low energy consumption & well maintained.	Equipment is appropriate for application with energy efficiency considered. Life cycle costs & energy efficiency are evaluated.	Regular condition surveys carried out on equipment & fabric elements affecting energy efficiency. Action undertaken for most defects identified.	Staff are aware of how they affect energy use & take all good housekeeping measures to save energy. Training on a regular basis.	Detailed descriptions of plant control & operation, & outline systems. Reasonable schedules of all plant, instrumentation & controls.	Targets set by budgeted production volumes using historical performance. Monitored for actual usage by production area.
2	Most equipment is not specifically energy efficient, but either was commissioned or is being regularly maintained for low energy consumption.	Equipment selected to be fit for purpose, bearing in mind likely life cycle costs & energy efficiency factors.	Condition surveys carried out regularly on all equipment & fabric elements affecting energy efficiency. Remedial work constrained by budgets.	Most good housekeeping practices are adhered to in an attempt to reduce energy usage. Occasional energy efficiency training received.	Basic descriptions of plant control & operation. Basic plant, instrumentation & control schedules for most control systems.	Targets set against realistic budgets, & maintained through financial procedures.
1	Equipment is not energy efficient, but has been commissioned for economy & undergoes periodic maintenance.	Power efficiency data on products obtained as part of selection process.	Condition surveys carried out occasionally, prompted by plant failure or safety considerations. Remedial work only carried out on major defects.	Energy-saving techniques are only adopted where they can be easily accommodated within traditional working practices.	Minimal or poor plant control & operation. Plant instrumentation & control schedules for only some of the plant & control systems.	Targets set by default through budget setting procedures.
0	Energy performance has not been considered during the procurement, commissioning or maintenance of existing plant & equipment.	No consideration of energy efficiency in plant equipment selection.	No regular surveys or maintenance carried out.	No consideration is given to energy efficiency during working operations.	None available.	No targets set.
Score						

4. Awareness and information

Knowledge is the key

As with any new activity, there is a need to both specify what people are going to do and to ensure that they are aware of their responsibilities.

One of the keys to energy management is to 'show results to get resources' and there is a need for clear reporting of successes in energy management to both get resources and to motivate the team. Equally there is a need to provide staff with training and development opportunities. A training course on variable-speed drives may appear a luxury but if it saves real money then it is a good investment in both the staff and the company. Further details of the benefits of training and the resources to carry this out are given in Sections 6.5 and 6.6.

Energy management is a rapidly developing field and there are very few people with experience or understanding of this area – keep staff well trained and up-to-date with the latest market developments.

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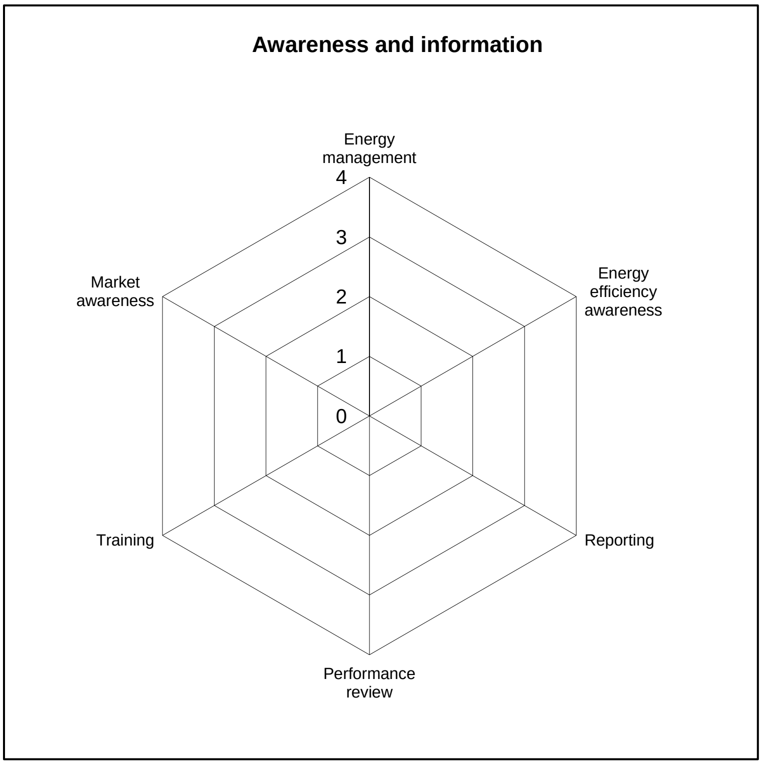

Basics - Awareness & information						2.4
Level	**Energy management**	**Energy efficiency awareness**	**Reporting**	**Performance review**	**Training**	**Market awareness**
4	Lists of responsibilities & their assignment exist & are comprehensive & regularly review ed. All staff have responsibilities.	Energy efficiency performance regularly given to all staff. Full use made of publicity. All methods used to promote new measures for saving energy	Wide reporting of current status compared w ith best practice, on regular basis & geared at a range of audiences. Full support to public statements	Progress regularly review ed. Performance compared against internal & external benchmarks. Ideas actively sought.	Training properly resourced for technical & premises staff. Active technical library. All staff have access to energy efficiency information	Keep abreast of technological developments by monitoring of trade journals, literature & other sources on issues affecting energy efficiency.
3	Lists of responsibilities & their assignment exist for key energy staff & all departments.	Energy efficiency status presented to all staff at least annually. Occasional but w idespread publicity to promote energy saving.	Current status reports issued annually to shareholders & staff. Impartial reporting of performance to staff & departments on a regular basis	Frequent energy efficiency review s using monitored consumption & cost data. Analysis is regular, w ide-ranging but ritualistic.	Continuous professional development for technical & premises staff. All staff are aw are of & have access to an energy efficiency library.	Regular studies carried out on trade journals, literature & other sources to assess current developments impacting on energy efficiency.
2	Some staff & departments have w ritten responsibilities.	Energy performance presented to staff on a regular basis. Occasional use of publicity to promote energy saving.	Occasional issue of energy efficiency status reports. Concentrates on good new s.	Occasional technical energy efficiency review s. Regular cost checks w ith exception reporting. Analysis of limited scope.	Technical & premises staff development by professional & technical journals. Occasional initiatives to train staff in energy efficiency.	Trade journals, literature & other sources scanned on an ad-hoc basis for information on the latest developments relating to energy efficiency.
1	Unw ritten set of responsibility assignments.	Energy performance occasionally reported & know n to very few staff. Energy-saving measures are rarely promoted.	Reports only issued if prompted by a business need. Most reports w ill contain only good new s.	Energy review activity based on revenue costs. Limited exception reporting only.	Few staff have know ledge of energy efficiency techniques & facts. Little training in energy efficiency for staff.	Trade journals, literature & other sources studied for energy implications w hen a purchase is imminent.
0	No evidence of assignment of energy efficiency tasks & duties.	No staff have explicit responsibilities or duties.	No reporting.	No monitoring activity to underpin review processes	Staff have little, if any, know ledge of energy efficiency. No attempt to inform staff of techniques & benefits of energy efficiency.	Energy efficiency not a consideration w hen keeping up to date on products or technology.
Score						

Part 3 Monitoring and targeting

1. Targeting and controlling

Targets count and drive improvement

Targeting and controlling is primarily concerned with having operational systems in place to get data from reliable sources, administering and controlling the data gathering, analysing the data to produce information and reports and externally auditing the process to make sure that the data and reports are accurate.

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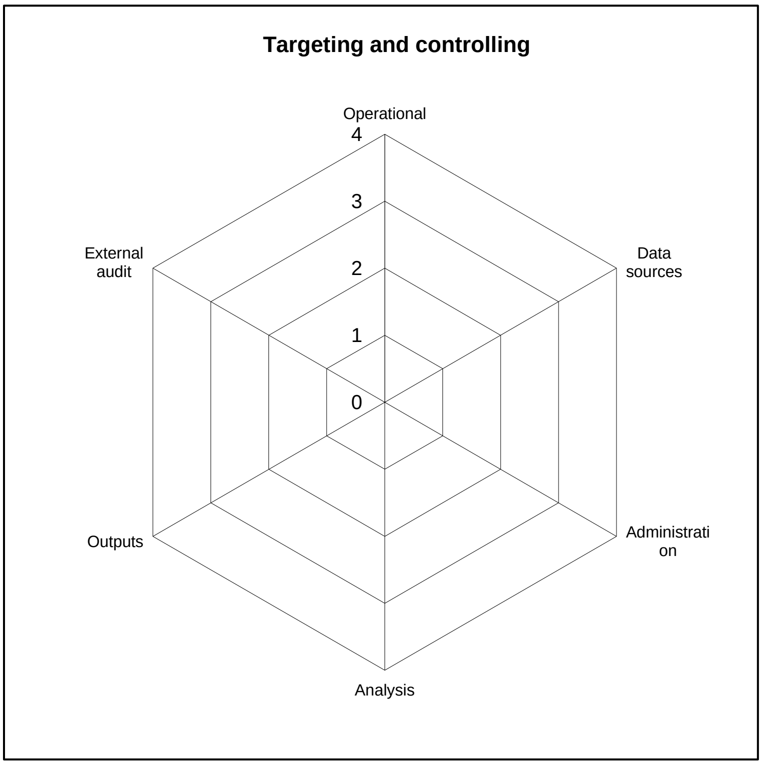


Monitoring and Targeting -Targeting & controlling						3.1
Level	**Operational**	**Data sources**	**Admin.**	**Analysis**	**Outputs**	**External audit**
4	Regular data promptly obtained & analysed. Management & operational information provided promptly & in relevant detail.	Excellent data sources. Updated machine database. Driver data (production volumes and temperatures) routinely obtained.	Meter readings taken in accordance with a written plan, driver & other recorded data collated & combined with relevant trading & business data.	Energy use analysis made on energy costs, production volumes & other factors. Targeting accuracy assessed to business needs.	Concise reports for managers to allow technical & financial data to be used. Data normalised for comparison. Impact of uncertainties defined.	Machine database, instrument calibration and energy prices checked. Reports checked for trends & anomalies.
3	All data obtained up to date & analysed so as to provide management information in adequate detail.	All data sources calibrated and reliable. Machine database OK. Production volumes & energy use recorded by shift.	All meter readings taken regularly, driver & other recorder data collated & combined with relevant trading & business data recording.	Energy use analysis made on energy costs, production volumes & other factors. Possible to compare with previous periods.	Concise reports for managers to allow technical & financial data to be used, with deviations from budget & comparisons with previous period.	Machine database checked regularly for accuracy. Instrumentation calibration verified. Market energy prices checked.
2	Provision of budget figures based on use adjusted for changes in base data (e.g. production volume corrected).	Most data sources calibrated and reliable. Energy use recorded on a routine basis or provided by supplier.	Most meter readings taken frequently, driver & other recorded data collated & combined with relevant trading & business data recording.	Energy use analysis with respect to energy costs, production volume & other parameters undertaken as required.	Reports prepared for managers giving both technical & financial data, deviations from budget & comparisons with previous period.	Machine database checked for accuracy. Ad hoc cursory check on reports & comparison with previous year.
1	Provision of budgetary figures based on use in corresponding periods.	Records kept of consumption based on bills from suppliers.	Occasional meter readings taken, driver & other recorded data collated & combined with relevant trading & business data recording.	Energy use analysis with respect to energy costs, production volume & other parameters carried out only in response to adverse trends.	Reports prepared & provided to managers incorporating both technical & financial data for the period.	Ad-hoc checks on machine database. Ad-hoc cursory check on reports & comparison with previous year.
0	No information of energy efficiency or consumption available.	No measurements taken & no records kept.	Information not collected.	No energy analysis prepared.	No management reports prepared.	No auditing function.
Score						

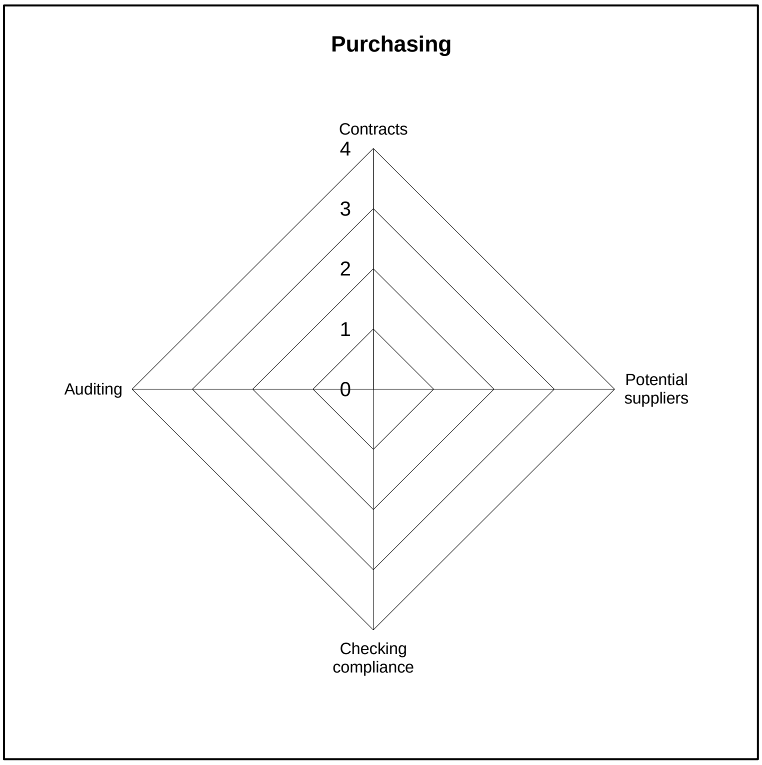
2. Purchasing

Purchasing

Purchasing any material or machine naturally affects the energy consumption of the process. Contracts for power supply naturally need to be examined carefully but all contracts and projects potentially affect energy use and need to be examined with this in mind. New materials or additives may appear more expensive but may reduce the energy use during processing. New machinery may reduce labour costs but may lead to increased energy costs that outweigh the benefits. The attitude of regarding energy as a fixed cost and labour as a variable cost can lead to complex automation projects that do not actually reduce costs overall.

Purchasing at all levels and in all areas needs to be aware that purchases can potentially lock either energy efficiency or energy inefficiency into the system.

Scoring



Monitoring and Targeting - Purchasing				3.2
Level	**Contracts**	**Potential suppliers**	**Checking compliance**	**Auditing**
4	Rolling programme to ensure all existing contracts reviewed to see if they need to cover energy efficiency issues. Where necessary, reference to energy efficiency inserted in tendering procedures for contract renewal.	Whenever appropriate, performance of suppliers is evaluated against established energy efficiency criteria. Wherever necessary, only those meeting criteria invited to tender	Wherever appropriate, regular & methodical checking by staff with appropriate expertise. Corrective action identified & subsequently monitored. Records maintained of supplier performance.	Wherever appropriate, completed contracts reviewed, with reporting of achieved levels of energy efficiency along with other critical aspects of supplier performance.
3	Most major contracts routinely reviewed to see whether they need to cover efficiency issues.	Agreed criteria for evaluating suppliers exist & routinely used to evaluate potential tenderers on most major contracts.	Periodic checking by experienced staff on most major contractors, identifying corrective actions & issuing instructions accordingly.	Most major completed contracts reviewed, with reporting of energy performance as one of regular topics addressed.
2	Some ad-hoc action taken to review whether major contracts need to cover energy efficiency issues.	Ad-hoc criteria exist & sometimes used to evaluate suppliers of services & purchases.	Ad-hoc approach to compliance checking against energy criteria only during other general inspections of progress.	No general auditing but ad-hoc action to review energy efficiency only if & when performance audited for other purposes.
1	Informal consideration of energy efficiency issues only in contracts specifically for energy goods or services.	Energy efficiency informally & occasionally used to evaluate potential suppliers only in contracts specifically for energy goods or services.	Informal & occasional checking only on contracts specifically for energy goods or services.	Informal & occasional auditing only on contracts specifically for energy goods or services.
0	Little or nothing known about the extent to which energy efficiency issues are dealt with in any of the organisation's current contracts.	Little or nothing known about the ability of existing suppliers to deliver energy efficient products or services in practice.	No attention paid during inspections to issues relating to energy efficiency.	No attention paid during post-contract auditing to issues relating to energy efficiency.
Score				

3. Energy projects

The energy management process

Choosing between energy management projects will always be difficult. There will always be too many projects competing for too few resources.

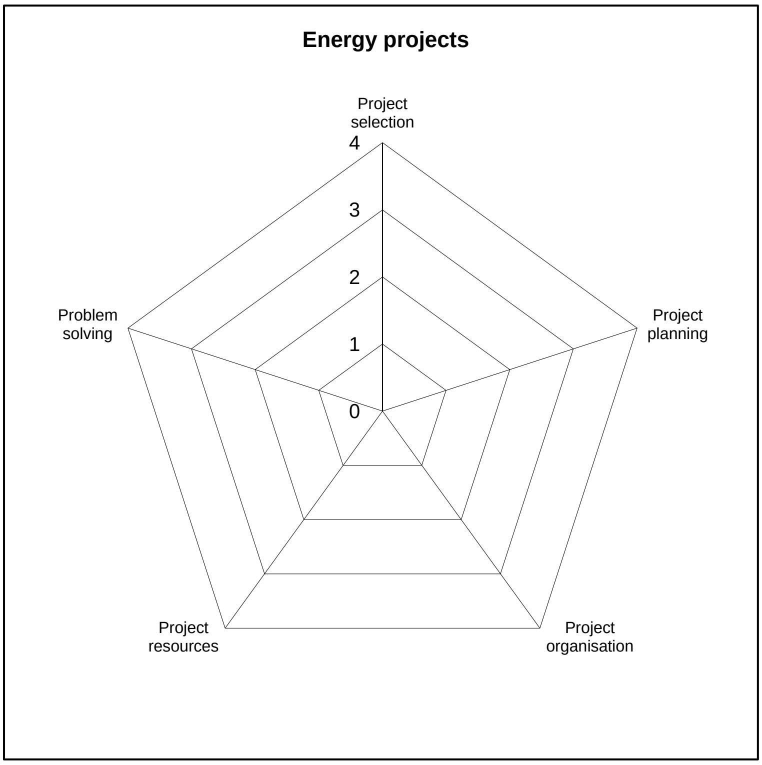
Companies need to rapidly assess the potential gains and difficulty of implementing any potential project before rushing into a complex project that has a relatively low-cost management potential.

Project selection is a key to energy management.

After projects have been selected then an effective project management system is an essential to actually delivering the project and achieving the potential gains.

Cross-functional teams are an invaluable tool for energy management due to the organisation of most companies.

Scoring



Monitoring and Targeting - Energy Projects					3.3
Level	**Project selection**	**Project planning**	**Project organisation**	**Project resources**	**Problem solving**
4	All relevant energy reduction opportunities identified & prioritised for action.	Formal project definition & project plan necessary for any project. Progress is regularly reported & post-project assessment is carried out.	Excellent energy reduction project management system used in all cases. Projects have clearly defined management & energy/benefits.	Project resources defined & allocated before project start. Projects are rarely delayed due to resource constraints.	Firmly embedded culture of improvement & problem solving through planning, action & review. Root causes identified & resolved.
3	Most available energy reduction opportunities identified but not prioritised for action.	Formal project planning carried out for all projects but control, reporting & assessment is variable. Failed projects are sometimes hidden & no lessons learnt.	Good energy reduction project management system but use is variable. Good integration across departments but many projects have poor energy/benefit definition.	Project resources defined but not allocated at project start.	Problem solving is largely reactive with focus on solving root causes. Solutions developed but not always fully implemented.
2	Some energy reduction opportunities identified but no real planning process.	Project planning carried out for most projects but control, reporting & assessment is poor or rarely carried out. Failed projects are often hidden & no lessons learnt.	Energy reduction project management system available but not used. Some integration of projects across departments & poor energy/benefit definition.	Project resources poorly defined at project start.	Problem solving is largely reactive; solutions are developed but rarely fully implemented. Focus on dealing with urgent effects & not on solving root causes.
1	Few energy reduction opportunities identified via unplanned process.	Cursory & undocumented project planning but no formal project planning or monitoring. Projects can become dormant & remain unfinished.	No energy reduction project management system. Some integration of departments for projects that clearly cross departmental boundaries.	Project resources rarely considered at project start.	Problem solving is purely reactive & focused on dealing with urgent effects & not on solving the root cause.
0	Significant energy reduction opportunities ignored due to 'urgent' daily pressures.	No effective project planning. Actions are ad hoc & driven by events. Action is seen as more important than planning.	No energy reduction project management system. Every project is 'different'. Projects are run by departments with little input from other departments.	Projects often started without adequate resources (due to poor planning) or starved of resources during project. Urgency is rated more highly than strategic importance.	Problems are ignored until they go away.
Score					

Part 4: Services

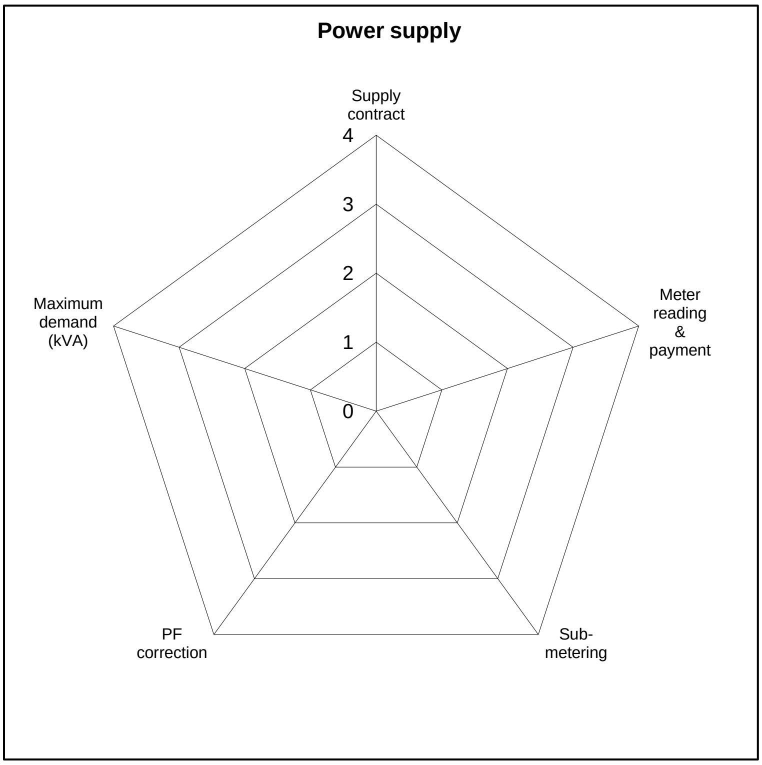
1. Power supply

The initial steps in power supply

Power supply basics are all about minimising the cost for energy and using the energy that you have paid for in the best possible manner.

Getting the supply contract right for the site, getting the right information from the supplier and minimising the costs are basics in energy management. Simple supply measurements from sub-metering or the main meter can provide valuable information to manage energy use and reduce costs.

Scoring



Services - Power supply 4.1

Level	Supply contract	Meter reading & payment	Sub-metering	PF Correction	Maximum demand (kVA)
4	Supply contract sent out for competitive tender based on current & projected needs.	Weekly checks of meters & consumption cross-checked against invoices. Interval data used to detect trends or exceptions. Invoices require approval of Production Manager	Excellent sub-metering enables M & T for major equipment & processes. Consumption data analysed to provide real information.	Excellent PF correction equipment in place, well maintained & operating correctly with PF > 0.98.	Maximum demand recorded as part of site facilities management. Adequate but not excessive MD capacity. Peak lopping procedures in place.
3	Supply contract sent out for competitive tender but based simply on current requirements.	Monthly checks of meters made & consumption cross-checked against supply invoices. Invoices require approval of Production Manager before payment.	Adequate sub-metering for requirements. Systems used for recording major equipment & processes & consumption but little analysis carried out.	Adequate PF correction equipment in place, adequately maintained with PF > 0.95.	Maximum demand tracked but no records kept. No concept of MD monitoring.
2	Supply contract sent out for competitive tender but based on poor knowledge of requirements.	Sporadic checks of meters made but no attempt to audit or validate supply invoices against meter readings. Invoices require approval of Production Manager before payment.	Poor sub-metering for requirements & no analysis carried out on information available.	Adequate PF correction equipment in place, poorly maintained with PF > 0.85 but < 0.95.	Maximum demand tracked intermittently but no records kept.
1	Supply contract renewed with current supplier with little tendering or negotiation process.	No checks of meters made. Payment made on invoice. Copies sent to Production Manager for information only.	No deliberate sub-metering. Limited sub-metering due to physical separation of site facilities.	Inadequate PF correction equipment in place. PF < 0.85.	Maximum demand tracked only for supply constraints. No records kept.
0	Supply contract renewed with current supplier with no tendering or negotiation process.	Supply invoices are accepted without validation & payment made on invoice without reference to Production Department.	No sub-metering available to provide information. Data available from single main meter only.	No PF correction equipment in place & Power Factor is < 0.80.	Maximum demand not tracked & no records kept. No concept of MD monitoring.
Score					

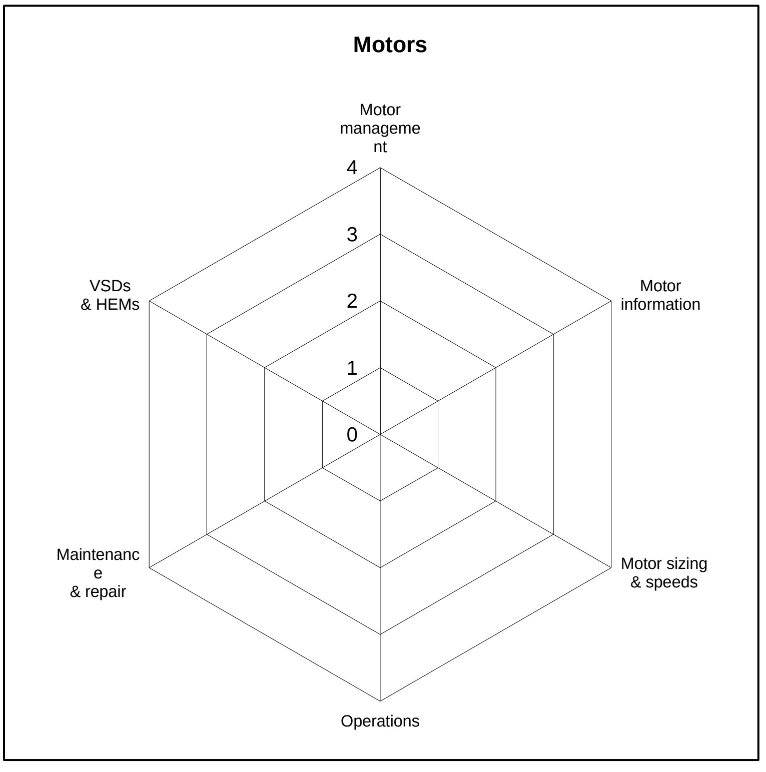
2. Motors

The initial steps in motors

Motors are the key to energy management in plastics processing due to the amount of electricity that is used in motors. Understanding where motors are used and adequately controlling their use is only part of motor management. It is just as important to ensure that a site has the right type of motors, i.e., energy-efficient motors, and uses these wisely through the use of VSDs when this is the appropriate method of control. Above all, the easiest way to save energy with motors is to ensure that they are switched off when not being used.

Motor management is crucial to successful energy management in plastics processing.

Scoring



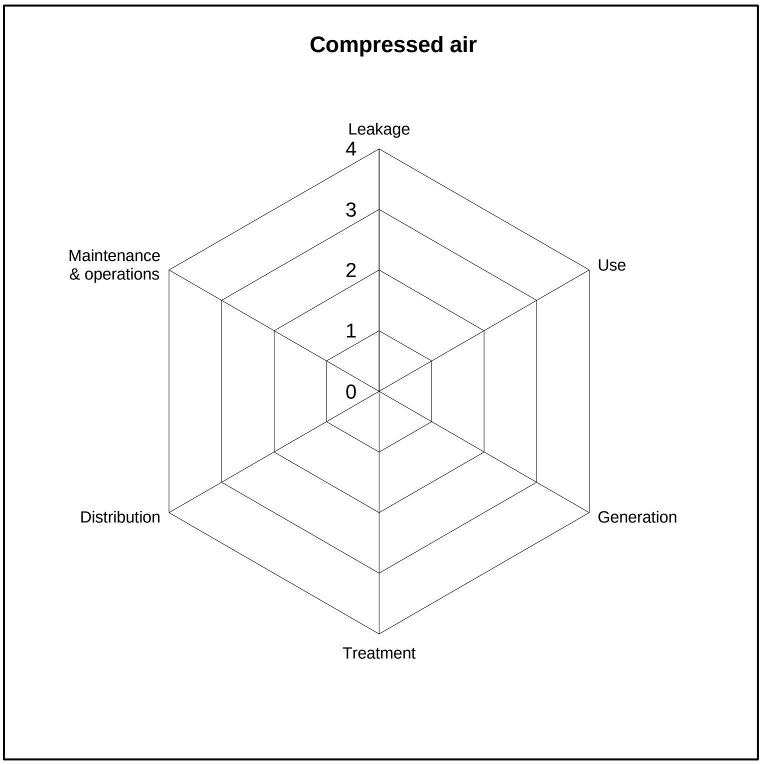
Services- Motors						4.2
Level	**Motor management**	**Motor information**	**Motor sizing & speeds**	**Operations**	**Maintenance & repair**	**VSDs & HEMs**
4	Motor management policy is widely available, widely publicised, approved by Senior Management & rigorously enforced.	Complete inventory of motors used at site & yearly running times. Detailed information available on motors using the most energy.	Detailed information on motor sizes & speed requirements available. Action taken to reduce all motor loads.	Motors are electrically controlled to switch off when job is complete or not needed.	Excellent motor maintenance carried out on all motors. Critical spares carried for most motors & wide range of spares carried for 'mission critical' motors.	VSDs & HEMs used in all applications where appropriate.
3	Motor management policy is widely available, widely publicised, approved by Senior Management but is not rigorously enforced.	List available of the major motors used at site & yearly running times. Some information available on motors using the most energy.	Information on motor sizes & speed requirements only for limited number of motors. Some action taken to reduce loads on large motors.	Policy of manual switch off of motors at job completion. Policy strictly enforced & adhered to.	Fair motor maintenance carried out on some motors. Small range of spares carried but only for 'mission critical' motors.	VSDs & HEMs used in some applications but large numbers of critical applications do not use the latest technology.
2	Motor management policy produced but not widely available, not publicised, not approved by Senior Management & not enforced.	Approximate knowledge of the largest motors on the site & their running times but no detailed information.	Some information on motor sizes & speed requirements available. No action taken to reduce any motor loads.	Policy of manual switch off of motors at job completion. Policy enforced variably & not well adhered to.	Poor or cursory motor maintenance carried out on all motors. Virtually no spares carried even for 'mission critical' motors.	Some application of VSDs & HEMs where specified externally by suppliers.
1	Unwritten motor management policy established by maintenance but often overridden by Senior Management.	Vague knowledge of the largest motors on the site.	No information on motor sizes & speed requirements available. No action taken to reduce any motor loads.	No policy of switching off motors. Ad hoc action taken by some staff. Some motors left running needlessly.	Little motor maintenance carried out & little knowledge of maintenance requirements. No spares stocked.	Knowledge of the benefits of VSDs & HEMs but no use even where applications are suitable & can save substantial amounts of energy.
0	No motor management policy available. All decisions are ad hoc, made at operational management level & inconsistent.	No information on motors used at the site.	No knowledge of motor sizing or speeds available.	No policy of switching off motors. Many motors left running needlessly.	No motor maintenance & no knowledge of maintenance requirements. No spares stocked. Maintenance carried out only when failed.	No knowledge of the applications for energy efficient VSDs or HEMs.
Score						

3. Compressed air

The initial steps in compressed air

Compressed air is one of the most expensive services provided to a site and getting the system right is vital to energy management. Compressed air is also one of the easiest services to target for reducing costs due to the huge amount of wastage in the area. Following a compressed air management programme is an easy and very structured method of reducing energy use and costs.

Scoring



Services - Compressed air						4.3
Level	**Leakage**	**Use**	**Generation**	**Treatment**	**Distribution**	**Maintenance & operations**
4	Excellent awareness of cost of leakage. Regular surveys (no-load testing) carried out. Leaks identified, tagged & promptly sealed.	High level of awareness of the compressed air cost. Only used for applications where absolutely necessary. Little chance of use reduction.	System sized & controlled to minimise cycling & control pressure. Minimum system demand known & delivered. Good air receiver capacity.	Air treated to lowest acceptable level. Local treatment used when needed. Well controlled drying practice & condensate collection.	Ring main distribution used & under constant review. Spurs can be isolated. Excellent system condition & pressure drops measured to find concerns.	Regular preventative maintenance & filter replacement. Waste heat recovered. Automatic condensate traps checked.
3	Good awareness of cost of leakage. Surveys carried out sporadically. Leaks identified but sealing action is sporadic.	Good awareness of use. Some small items use compressed air. Use monitored but no substantive action taken.	System size OK but poor control. Minimum system demand approximately known but poorly controlled. Adequate air receiver capacity.	Air treated to low level with no local treatment. Adequate drying & condensate collection but few controls in place. Good drying pressures & temperatures.	System regularly reviewed. Spurs are capable of isolation when not in use but never actually isolated.	Regular maintenance checks & occasional action. Low level preventative maintenance so that system continues to operate.
2	Moderate awareness of cost of leakage. Surveys rarely carried out. Leaks identified on an ad hoc basis only. Sealing action is rarely taken.	Moderate consideration of use. High number of items use compressed air. Compressed air is monitored but no action taken.	System correctly sized but poor control & cycling when not required. System demand only vaguely known. Poor air receiver capacity.	Moderate air quality provided irrespective of need. Poor drying & condensate collection with no controls in place. High pressure drops at dryers.	System review is over 12 months old.	Maintenance checks carried out regularly but little action taken. Maintenance only to ensure that system continues to operate, i.e servicing only.
1	Low awareness of cost of leakage. No leakage surveys carried out.	Little consideration of use. High use for motive power, drying & cleaning. Misuse of compressed air is discouraged but accepted.	System badly sized & poorly controlled, cycling when not required. System demand unknown. Air receiver inadequate for demand.	High air quality provided irrespective of need. Little control of drying & condensate collection. Excessive pressure drop across dryers.	System review is over 3 years old. Large number of redundant spurs with no isolation. Distribution system in poor condition (visible distortion & corrosion.	Sporadic maintenance of filter systems (when problem is noted with the system).
0	High leakage rate & no awareness of cost. No leakage surveys carried out, significant air leakage identified on cursory inspection but no action taken.	No consideration of use. Many items use compressed air for motive power, drying & cleaning. Misuse of compressed air is common & ignored.	System oversize, idling when not required & cycling due to poor controls. System demand & minimum pressure needed unknown. Warm air intake.	Highest air quality provided irrespective of need.	Distribution system not reviewed since installed. Many redundant spurs with no isolation. System is old, corroded & has many sharp bends & corners.	Components dirty & not cleaned. No maintenance of treatment system. Filters clogged. Manual condensate traps jammed open & not maintained.
Score						

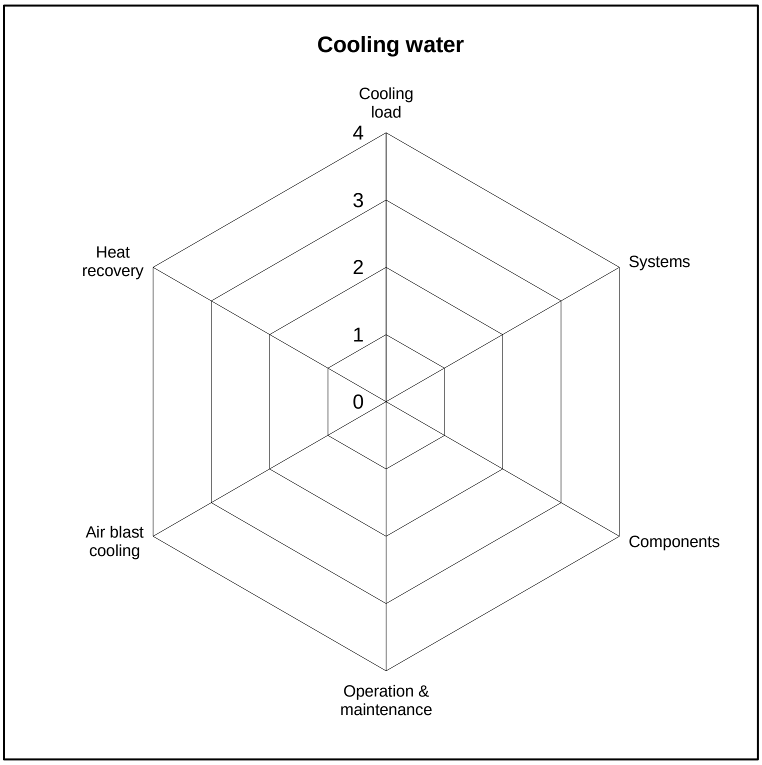
4. Cooling and chilled water

A major hidden cost

The temperature setting of cooling water is often justified on the basis of improved throughput but rarely do we see a true cost–benefit calculation of the justification and often this is simply a case of 'what gets measured gets done and what doesn't get measured is ignored'. Production rates get measured and energy costs don't – guess which gets done?

In some processes, the provision of cooling water and pumping it around a site is one of the largest avoidable costs in the process and simple actions can reduce the costs considerably.

Scoring



Services - Cooling water						4.4
Level	**Cooling load**	**Systems**	**Components**	**Operation & maintenance**	**Air blast cooling**	**Heat recovery**
4	Cooling load minimised & maximum temperature possible used. Pipework & all areas well insulated against parasitic loads.	System optimised for current loading. Pipework & pumps reviewed within 12 months & well suited for current loading. Good ventilation over chiller parts.	New technology (scroll & screw) compressors used. All pumps & fans sized correctly & IE4 & VSD pumps & fans used to match process demands.	Records of plant condition & service. Regular check on flow & return temps, gas tightness & refrigerant charge. Clean heat exchanger	Air blast cooling used for major cooling load.	Heat recovery from cooling system used extensively for space & water pre-heating.
3	Good attempt to minimise parasitic loads but poor control of maximum temperature required for the system.	System review is over 12 months old. Moderate ventilation over chiller parts.	Majority of equipment is new technology (scroll & screw compressors, IE3 & VSD pumps & fans). Programme to replace old equipment.	Good regulatory records kept & good service records. Regular checks on system temps & heat exchanger surfaces.	Air blast cooling installed as trial before full implementation.	Heat recovered from cooling system used partially & effectively.
2	Some attempt to minimise parasitic loads but not extensive. Cooling load only vaguely known & maximum temperature not minimised.	System review is over 3 years old. Large amount of old piping & poor insulation. Distribution system has visible distortion & corrosion present.	Most equipment is old & operates excessively & irrespective of process demand. Recognition of upgrades available & action being taken on rolling basis.	Minimum regulatory records kept & some poor service records. Few checks on system temps & heat exchanger surfaces.	Air blast cooling planned for installation in short term.	Heat recovered from cooling system used partially but ineffectively.
1	Poor attempt to minimise parasitic loads. High parasitic loads e.g., badly insulated pipes. No idea of maximum temperature needed.	System not optimised or reviewed since installation. Poor ventilation over chiller parts.	All equipment is old. Fixed speed pumps & fans operate irrespective of demand. Recognition of upgrades available but no action.	Only regulatory records kept (leak testing for refrigerants). No other records available. No checks on system temps or heat exchanger surfaces.	Air blast cooling considered & still under consideration.	Heat recovery considered but not attempted.
0	No attempt to minimise high parasitic loads e.g., badly insulated pipes. Cooling is supplied to many areas with no idea of maximum temperature.	System not optimised or reviewed since installation. Very poor ventilation over chiller parts.	All equipment is old. Fixed speed pumps & fans operate irrespective of process demand. No recognition of possible upgrades available	No records of meeting regulatory requirements. No regular maintenance carried out. System in poor overall condition.	Air blast cooling not known of & not considered.	Heat recovery possibilities not known or considered.
Score						

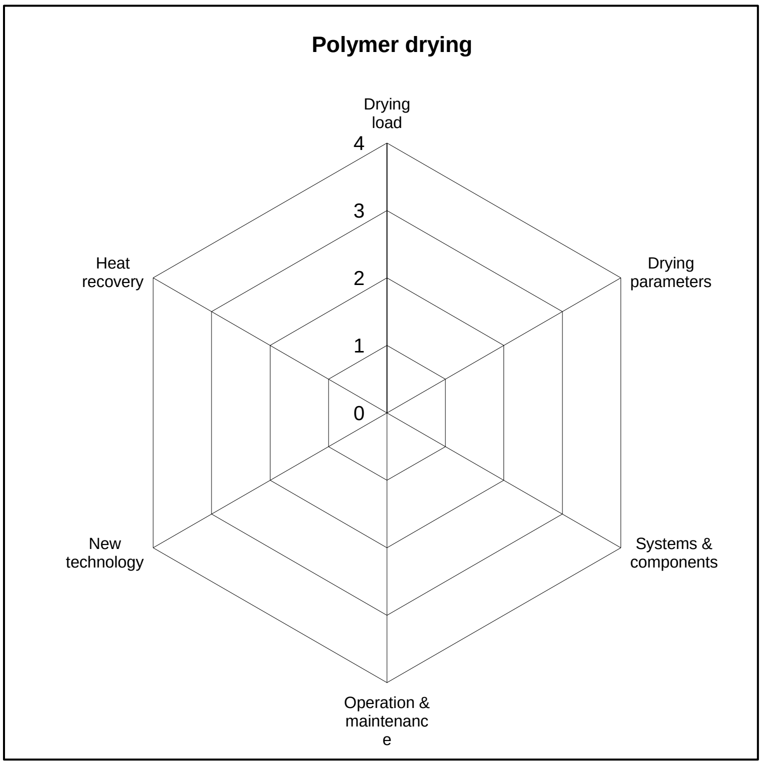
5. Polymer drying

Make sure it is actually needed

Drying is another hidden service that uses large amounts of energy to operate and is frequently misused or overused. Drying is rarely considered in the average site but at sites where drying takes place it is one of the significant energy use areas.

Drying is weather-dependent yet most sites take no account of the weather in the storage and handling of raw materials (it is all going to be dried anyway so why worry about it) and drying cycles are rarely adjusted for the weather conditions. Simple techniques are easily implemented to reduce the amount of drying carried out at most sites.

Scoring



Services - Polymer drying						4.5
Level	**Drying load**	**Drying parameters**	**Systems & components**	**Operation & maintenance**	**New technology**	**Heat recovery**
4	Excellent practice in minimising drying load by excellent storage & handling.	Drying parameters adjusted for weather & full use made of natural conditions. Materials dried according to need.	Systems based on best performance for current requirements. Dew point of drying air well controlled for optimum drying energy use.	Full preventative maintenance programme in place for all system components.	New technologies investigated & installed where appropriate.	Heat recovered from drying system & used extensively for pre-heating.
3	Good attempt to minimise drying load but unsuccessful due to poor storage & handling.	Drying parameters adjusted for weather & partial use made of natural conditions. Materials dried according to need.	Systems based on good performance for current requirements. Dew point of drying air poorly controlled.	Good maintenance based on actual performance of drying system & triggered by alarms for potential failure.	New technologies fully investigated & found appropriate but not installed.	Heat recovered from drying system & partially used for pre-heating.
2	Poor attempt to minimise drying load.	Drying parameters adjusted for weather. Drying parameters adjusted for material to be dried.	Systems based on previous requirements. Dew point of drying air measured but not controlled.	Poor maintenance based on annual maintenance schedule only irrespective of operations.	New technologies partially investigated but no conclusions made.	Heat recovered from drying system used partially but ineffectively.
1	Unaware of need to minimise drying load. No attempt to minimise drying load by appropriate storage & handling.	Drying parameters not adjusted for weather. Drying parameters adjusted for material to be dried.	Systems selected based on previous requirements & poor for current requirements. Dew point of drying air considered but not measured.	No maintenance unless production problems seen.	Aware of possibilities of new technologies but not investigated.	Heat recovery considered but not attempted.
0	Unaware of the need to minimise drying load. Drying load is increased by inappropriate storage & handling.	Drying parameters not adjusted for weather. All materials dried as part of normal procedure.	Systems selected based on previous requirements & unsuitable for current requirements. Dew point of drying air not considered or measured.	No maintenance even when production problems seen.	Possibility of new technologies unknown & not investigated.	Heat recovery possibilities not known or considered.
Score						

Part 5: Processing

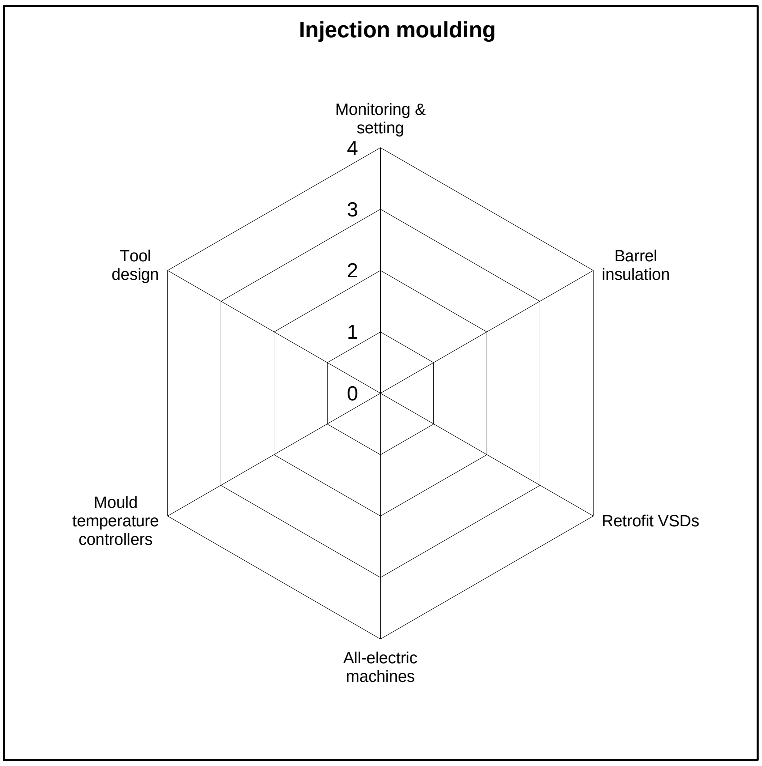
1. Injection moulding

An energy intensive process

Injection moulding is one of the most common processing methods and significant improvements have been made in recent years in both the understanding of the process and in technologies to reduce energy use. Setting is now a science rather than an art, barrel insulation is now a proven technology, all-electric machines continue to develop in size and accuracy and ancillaries have also been improved.

Companies in the injection moulding sector have a wide variety of possible actions available to reduce energy use and to establish a competitive advantage.

Scoring



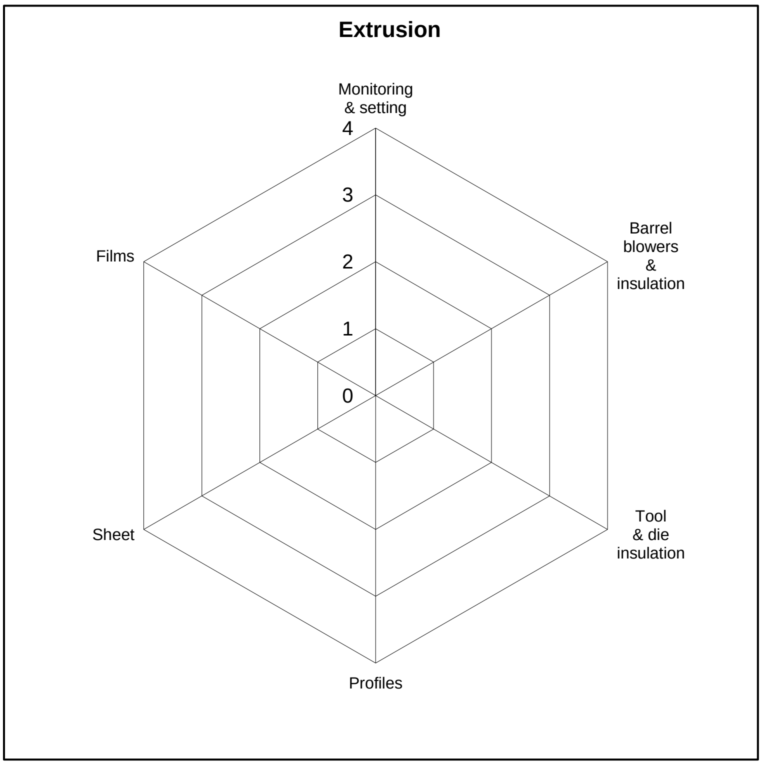
Processing - Injection moulding							5.1
Level	**Monitoring & setting**	**Barrel insulation**	**Retrofit VSDs**	**All-electric**	**Mould temperature controllers**	**Tool design**
4	Machine settings checked & validated against best practice. Most machines monitored for energy efficiency & performance.	Full barrel insulation in good condition. New generation barrel insulation used. Very little heat lost to the surrounding area.	Retrofit VSD drives fitted to over 50% of applicable machines.	All-electric machines are over 50% of applicable machines & are default purchase option for all new machines.	MTCs only used w hen absolutely necessary. Use is controlled by setting sheets. All hoses are w ell insulated to reduce heat transfer.	Tool design takes energy into account in all areas. Compressed air usage is small & controlled. Good control & use of cooling.
3	Very few machine settings show deviations from good practice. Some machines monitored for energy efficiency & performance.	Full barrel insulation in poor condition w ith visible degradation of insulation material.	Retrofit VSD drives fitted to under 50% of applicable machines.	All-electric machines are less than 50% of applicable machines. Purchase of all-electric machines is still subject regarded as 'advanced'.	MTCs theoretically only used w hen necessary but actual use is poor. All hoses are w ell insulated to reduce heat transfer.	Tool design takes productivity & energy into account but there is some poor use of services in the process.
2	Small number of machine settings show deviations from good practice. No machines monitored for energy efficiency & performance.	Partial barrel insulation in good condition. Reduced amounts of heat lost to surrounding area.	Retrofit VSD drives under evaluation for selected machines.	All-electric machine under evaluation as test before full implementation.	MTCs theoretically only used w hen necessary but actual use is poor. No insulation on hoses & heat transfer is significant.	Tool design is good for productivity & has small sprues & runners (or hot runners) but poor for energy through the poor use of services.
1	Significant number of machine settings show deviations from good practice.	Partial barrel insulation in poor condition. Moderate amounts of heat lost to general site area.	Retrofit VSD drives considered but not purchased.	All-electric machines considered but not purchased.	MTCs used on some tools & use is uncontrolled. Large heat losses through the use of uninsulated & poorly chosen hoses.	Energy efficiency is minor consideration in tooling. Tool design has large sprues & runners & uses services very poorly.
0	Most machine settings show deviation from good practice or recommended values.	Barrel guarding but no barrel insulation. Large amounts of heat lost from uninsulated barrel to site.	Retrofit VSD drives not considered & not aw are of possibilities.	All-electric machines not considered despite being applicable for the operations.	MTCs used on most tools & use is uncontrolled. Large heat losses through the use of uninsulated & poorly chosen hoses.	Energy not considered in tooling. Mould heating & cooling w ork against one another. Tool uses compressed air for many actions.
Score						

2. Extrusion

A basic process for plastics

Extrusion is a key process in plastics processing and forms the basis for a wide variety of distinct sectors. Progress has not been as rapid as in injection moulding but sites using extruders still have a wide variety of possible improvement actions available to reduce energy use. The correct setting of machines, the use of insulation in areas where shear heating is not providing the required heat input, the increasing application of AC motors and VSDs on main extruder drives and the wider application of AC motors and VSDs in the control of ancillaries all provide fertile ground for improvements in extrusion.

Scoring



Processing - Extrusion						5.2
Level	**Monitoring & setting**	**Barrel blowers & insulation**	**Tool & die insulation**	**Profiles**	**Sheet**	**Films**
4	Machine settings checked & validated against best practice. Most machines monitored for energy efficiency & performance.	Full insulation in good condition upstream from screw tip where applicable. New generation heater/blowers. Very low heat losses & good heating control.	Full insulation on hot areas downstream from screw tip & insulation in good condition. Very low heat losses.	Excellent match of motor & gear ratios to profile. Excellent control of vacuum generation & use (no leaks). Cooling water well controlled.	Excellent control of co-extruder. Automation of sheet thickness control. Ventilation VSD controlled. Edge trim regranulators automatic 'off'.	Excellent use of VSDs in all applicable areas. Post-treatment uses no excessive energy, e.g., good insulation & closed energy use.
3	Very few machine settings show deviations from good practice. Some machines monitored for energy efficiency & performance.	Full insulation upstream from screw tip where applicable or insulation present & in good condition. Reduced heat losses.	Full insulation on hot areas downstream from screw tip & in good condition. Reduced heat losses.	Motor & gear ratios well matched to profile. Vacuum generation & use good. Cooling water distribution & contact good.	Good control of co-extruders. Automated sheet thickness control. Ventilation automatic 'off'. Edge trim regranulators automatic 'off'.	Good use of VSDs in most applicable areas. Post-treatment uses excessive energy, e.g., moderate insulation & partially closed energy use.
2	Small number of machine settings show deviations from good practice.	Partial insulation upstream from screw tip where applicable, e.g., materials feed area or insulation present but in poor condition. Moderate heat losses.	Partial insulation on hot areas downstream from screw tip or insulation present but in poor condition. Moderate heat losses.	Motor & gear ratios poorly matched to profile. Vacuum generation & use good. Cooling water distribution & contact good.	Good control of co-extruders. Better manual control of sheet thickness (SPC). Ventilation manual 'off'. Edge trim regranulators manual 'off'.	Moderate use of VSDs in some areas. Post-treatment uses excessive energy, e.g., low insulation or partially open energy use.
1	Significant number of machine settings show deviations from good practice.	Safety guarding present for hot areas upstream from screw tip but no insulation on any hot area. Large heat losses.	Safety guarding present for hot areas downstream from screw tip but no insulation on any hot area. Large heat losses.	Motor & gear ratios poorly matched to profile. Vacuum generation & use poor. Cooling water distribution & contact good.	Poor control of co-extruders. Good manual control of sheet thickness. Ventilation manual 'off'. Edge trim regranulators manual 'off'.	Low use of VSDs in few areas. Post-treatment uses highly excessive energy, e.g., low insulation or open energy use.
0	Most machine settings show deviations from good practice or recommended values.	No safety guarding present for hot areas upstream from screw tip. Risk of contact with hot surfaces. Large heat losses.	No safety guarding present for hot areas downstream from screw tip. Risk of contact with hot surfaces. Large heat losses.	Motor & gear ratios poorly matched to profile. Vacuum generation & use poor. Cooling water distribution & contact poor.	Poor control of co-extruders. Poor manual control of sheet thickness. Ventilation permanently on. Edge trim regranulators permanently on.	No use of VSDs. Post-treatment carried out poorly with highly excessive energy use, e.g., poor insulation or open energy use.
Score						

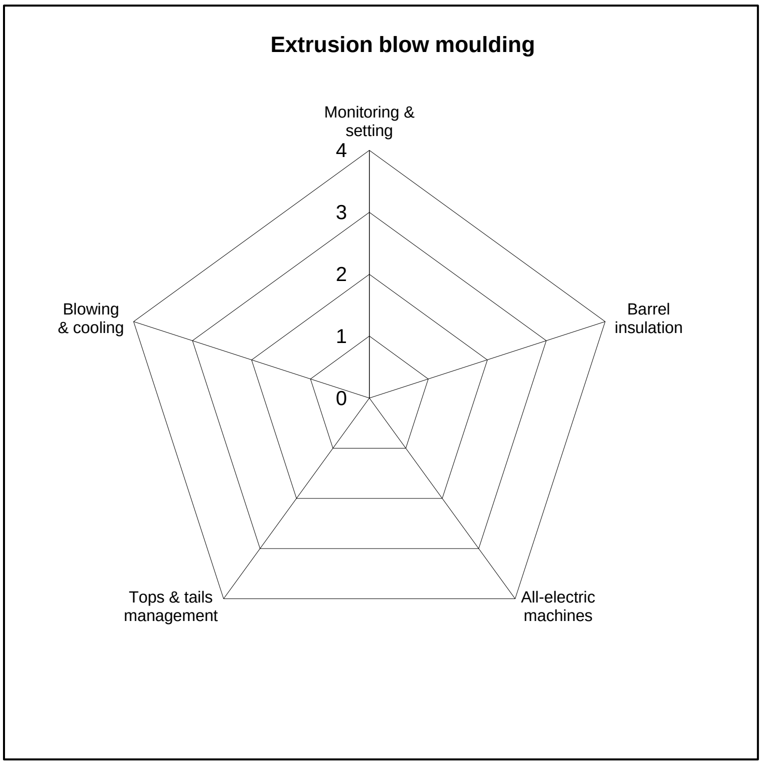
3. Extrusion blow moulding

Tops and tails are key

Extrusion blow moulding needs many of the controls associated with conventional extrusion but good parison control and careful process setting to minimise tops and tails are the keys to both minimising energy use and maximising process productivity.

All-electric machines are also now becoming available for extrusion blow moulding and will affect the whole basis of energy use in the sector.

Scoring



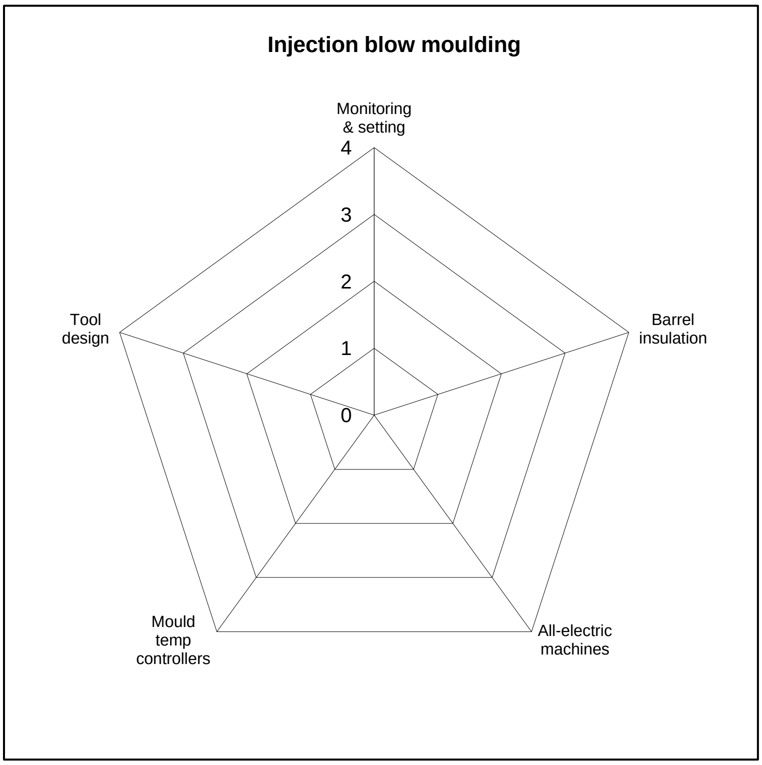
Processing - Extrusion blow moulding					5.3
Level	**Monitoring & setting**	**Barrel insulation**	**All-electric**	**Tops & tails management**	**Blowing & cooling**
4	Machine settings checked & validated against best practice. Most machines monitored for energy efficiency & performance.	Full barrel insulation in good condition. New generation barrel insulation used. Very little heat lost to the surrounding area.	All-electric machines are over 50% of applicable machines & are default purchase option for all new machines.	Tops & tails minimised & recorded for all products before job released. Setters have close targets for tops & tails. No job released until targets met.	Accumulators minimise transient air demands. Blow & hold pressures checked & minimised. Optimum demould temperature.
3	Very few machine settings show deviations from good practice. Some machines monitored for energy efficiency & performance.	Full barrel insulation in poor condition with visible degradation of insulation material.	All-electric machines are less than 50% of applicable machines. Purchase of all-electric machines is still subject regarded as 'advanced'.	Tops & tails minimised for most products before job released. Setters given targets but often overridden by desire to get job into production.	Accumulators minimise transient air demands. Blow & hold pressures reduced. Increased demould temperature.
2	Small number of machine settings show deviations from good practice. No machines monitored for energy efficiency & performance.	Partial barrel insulation in good condition. Reduced amounts of heat lost to surrounding area.	All-electric machine under evaluation as test before full implementation.	Tops & tails minimised for some products before job released. Setters given targets but not controlled or recorded.	Small accumulator – large transient air demands. Blow & hold pressures reduced. Moderate demould temperature.
1	Significant number of machine settings show deviations from good practice.	Partial barrel insulation in poor condition. Moderate amounts of heat lost to general site area.	All-electric machines considered but not purchased.	Tops & tails management considered but not implemented. Tops & tails uncontrolled. Setters look at tops & tails but main task is starting machine.	No accumulator – high transient air demands. Blow & hold pressures reduced. Low demould temperature used.
0	Most machine settings show deviation from good practice or recommended values.	Barrel guarding but no barrel insulation. Large amounts of heat lost from uninsulated barrel to site.	All-electric machines not considered despite being applicable for the operations.	No concept of tops & tails management. Tops & tails uncontrolled. Setters task is to simply get the job running.	No accumulator – high transient air demands. High blow & hold pressures used. Very low demould temperature used.
Score					

4. Injection blow moulding

An integrated process

IBM shares many technological characteristics with conventional injection moulding. Many of the techniques for reducing energy use in injection moulding can be simply and directly transferred to IBM. These include improved setting, barrel insulation, improved motors and drives, all-electric machines, improved control of ancillaries and improvements in tool design. The additional blowing step needs control but does not add much to the direct energy use of the machine, although it adds it through the increased use of services such as compressed air for blowing.

Scoring



Processing - Injection blow moulding					5.4
Level	**Monitoring & setting**	**Barrel insulation**	**All-electric**	**Mould temperature controllers**	**Tool design**
4	Machine settings checked & validated against best practice. Most machines monitored for energy efficiency & performance.	Full barrel insulation in good condition. New generation barrel insulation used. Very little heat lost to the surrounding area.	All-electric machines are over 50% of applicable machines & are default purchase option for all new machines.	MTCs only used when absolutely necessary. Use is controlled by setting sheets. All hoses are well insulated to reduce heat transfer.	Tool design takes energy into account in all areas. Compressed air use is small & controlled. Good control & use of cooling.
3	Very few machine settings show deviations from good practice. Some machines monitored for energy efficiency & performance.	Full barrel insulation in poor condition with visible degradation of insulation material.	All-electric machines are less than 50% of applicable machines. Purchase of all-electric machines is still subject regarded as 'advanced'.	MTCs theoretically only used when necessary but actual use is poor. All hoses are well insulated to reduce heat transfer.	Tool design takes productivity & energy into account but there is some poor use of services in the process.
2	Small number of machine settings show deviations from good practice. No machines monitored for energy efficiency & performance.	Partial barrel insulation in good condition. Reduced amounts of heat lost to surrounding area.	All-electric machine under evaluation as test before full implementation.	MTCs theoretically only used when necessary but actual use is poor. No insulation on hoses & heat transfer is significant.	Tool design is good for productivity but poor for energy through the poor use of services.
1	Significant number of machine settings show deviations from good practice.	Partial barrel insulation in poor condition. Moderate amounts of heat lost to general site area.	All-electric machines considered but not purchased.	MTCs used on some tools & use is uncontrolled. Large heat losses through the use of uninsulated & poorly chosen hoses.	Energy efficiency is minor consideration in tooling. Tool design uses services very poorly.
0	Most machine settings show deviation from good practice or recommended values.	Barrel guarding but no barrel insulation. Large amounts of heat lost from uninsulated barrel to site.	All-electric machines not considered despite being applicable for the operations.	MTCs used on most tools & use is uncontrolled. Large heat losses through the use of uninsulated & poorly chosen hoses.	Energy not considered in tooling. Mould heating & cooling work against one another. Tool uses compressed air for many actions.
Score					

5. Injection stretch blow moulding

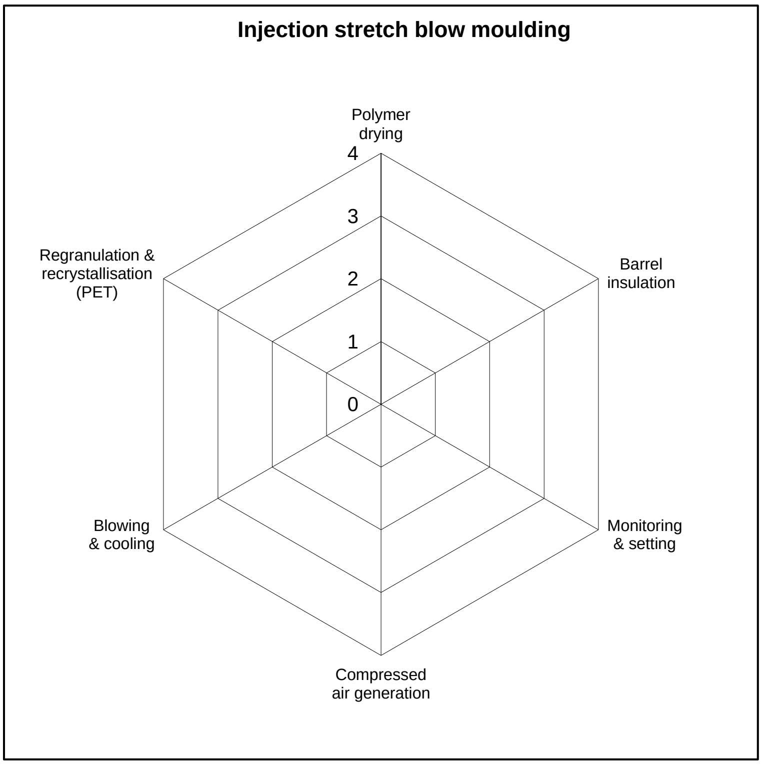
The process for water bottles

ISBM shares many technology characteristics with conventional injection moulding. Many of the techniques for reducing energy use in injection moulding can be simply and directly transferred to ISBM. These include improved setting, barrel insulation and all-electric machines.

The blow step of ISBM is also an area for energy management improvements ranging from how blow air is generated and used through to how the IR heaters are specified and controlled.

When injection blow moulding PET, the regranulation and recrystallisation of the regranulated material can be improved by new drying methods that combine the two processes.

Scoring



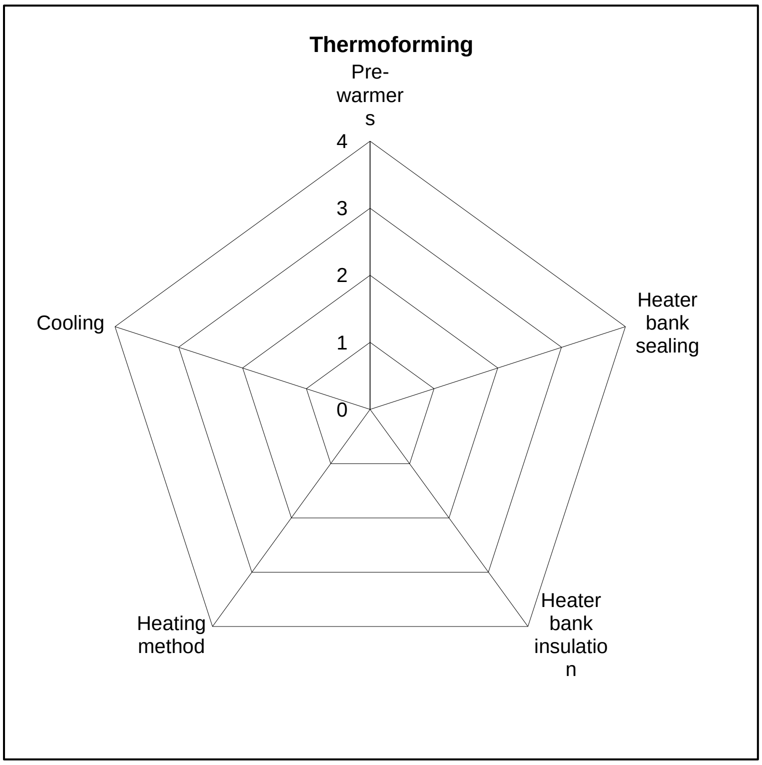
Processing - Injection stretch blow moulding						5.5
Level	**Polymer drying**	**Barrel insulation**	**Monitoring & setting**	**Compressed air generation**	**Blowing & cooling**	**Regran. & recryst.**
4	Systems based on best performance for current requirements. Dew point of drying air well controlled for optimum drying energy use.	Full barrel insulation in good condition. New generation barrel insulation used. Very little heat lost to the surrounding area.	Machine settings checked & validated against best practice. Most machines monitored for energy efficiency & performance.	System sized & controlled to minimise cycling & control pressure. Minimum system demand known & delivered. Good air receiver capacity.	Accumulators minimise transient air demands. Blow & hold pressures checked & minimised.	Regranulation automatically controlled to operate only when needed. Drying & recrystallisation are combined in one-step process.
3	Systems based on good performance for current requirements. Dew point of drying air poorly controlled.	Full barrel insulation in poor condition with visible degradation of insulation material.	Very few machine settings show deviations from good practice. Some machines monitored for energy efficiency & performance.	System size OK but poor control. Minimum system demand approximately known but poorly controlled. Adequate air receiver capacity.	Accumulators minimise transient air demands. Blow & hold pressures reduced.	Regranulation manually operated only when needed & controls are good. Drying & recrystallisation are combined in one-step process.
2	Systems based on previous requirements. Dew point of drying air measured but not controlled.	Partial barrel insulation in good condition. Reduced amounts of heat lost to surrounding area.	Small number of machine settings show deviations from good practice. No machines monitored for energy efficiency & performance.	System correctly sized but poor control & cycling when not required. System demand only vaguely known. Poor air receiver capacity.	Small accumulator – large transient air demands. Blow & hold pressures reduced.	Regranulation manually operated only when needed & controls are good. Drying process separate from recrystallisation process.
1	Systems selected based on previous requirements & poor for current requirements. Dew point of drying air considered but not measured.	Partial barrel insulation in poor condition. Moderate amounts of heat lost to general site area.	Significant number of machine settings show deviations from good practice.	System badly sized & poorly controlled, cycling when not required. System demand unknown. Air receiver inadequate for demand.	No accumulator – high transient air demands. Blow & hold pressures reduced.	Regranulator manually operated only when needed but controls are poor. Drying process separate from recrystallisation process.
0	Systems selected based on previous requirements & unsuitable for current requirements. Dew point of drying air not considered or measured.	Barrel guarding but no barrel insulation. Large amounts of heat lost from uninsulated barrel to site.	Most machine settings show deviation from good practice or recommended values.	System oversize, idling when not required & cycling due to poor controls. System demand & minimum pressure needed unknown. Warm air intake.	No accumulator – high transient air demands. High blow & hold pressures used.	Regranulator operates continuously whether needed or not. Drying process separate from recrystallisation process.
Score						

6. Thermoforming

Tubs and trays

Thermoforming is a widely used process but, in contrast to other processes, the technical advances for energy management in the process have not been either rapid or widely distributed throughout the industry. There are still many areas where the industry can reduce energy use and improve competitiveness with relative ease. There is still much to be done in the industry.

Scoring



Processing - Thermoforming					5.6
Level	**Pre-warmers**	**Heater bank sealing**	**Heater bank insulation**	**Heating method**	**Cooling**
4	Pre-warmers have excellent seals at entrances & exits & are fully insulated. Door seals in excellent condition. Pre-warmers have negligible heat losses.	Heater banks have excellent seals at entrances & exits. Very low heat losses at heater bank entrances & exits.	Heater banks have excellent insulation & radiation protection. Very low heat losses at heater banks from conduction, convection & radiation.	Heater emissivity matched to material absorption. Ceramic/quartz heaters used & serviced regularly. New technologies investigated & implemented if appropriate.	Excellent tool cooling with good arrangement & operation. Cooling optimised for minimum cycle time.
3	Pre-warmers have excellent seals at entrances & exits & some insulation. Door seals in good condition. Pre-warmers have low heat losses.	Heater banks have good seals at entrances & exits. Low heat losses at heater bank entrances & exits.	Heater banks have good insulation & radiation protection. Low heat losses at heater banks from conduction, convection & radiation.	No matching of heater emissivity & material absorption. Ceramic/quartz heaters used but irregularly serviced. New technologies not investigated.	Good tool cooling with some limited optimisation of cooling arrangement. Good cycle times.
2	Pre-warmers have good seals at entrances & exits & some insulation. Door seals in good condition. Pre-warmers have average heat losses.	Heater banks have average seals at entrances & exits. Moderate heat losses at heater bank entrances & exits.	Heater banks have some insulation & radiation protection. Moderate heat losses at heater banks from conduction, convection & radiation.	No matching of heater emissivity & material absorption. Ceramic/quartz heaters used but rarely serviced.	Acceptable tool cooling arrangements. Average cooling & cycle times.
1	Pre-warmers have average seals at entrances & exits & are poorly insulated. Door seals in poor condition. Pre-warmers have high heat losses.	Heater banks have poor seals at entrances & exits. High heat losses at heater bank entrances & exits.	Heater banks have little insulation or radiation protection. High heat losses at heater banks from conduction, convection & radiation.	No matching of heater emissivity & material absorption. Ceramic/quartz heaters used but never serviced.	Tool cooling poorly arranged & operated. Average cooling & cycle times.
0	Pre-warmers have poor seals at entrances & exits & are poorly insulated. Door seals visibly degraded or missing. Pre-warmers have very high heat losses.	Heater banks have no seals at entrances & exits. Very high heat losses at heater bank entrances & exits.	Heater banks have no insulation or radiation protection. Very high heat losses at heater banks from conduction, convection & radiation.	Convective rod heaters used & not matched to material. Poor servicing of heaters.	Tool cooling not optimised. Poor cooling & high cycle times.
Score					

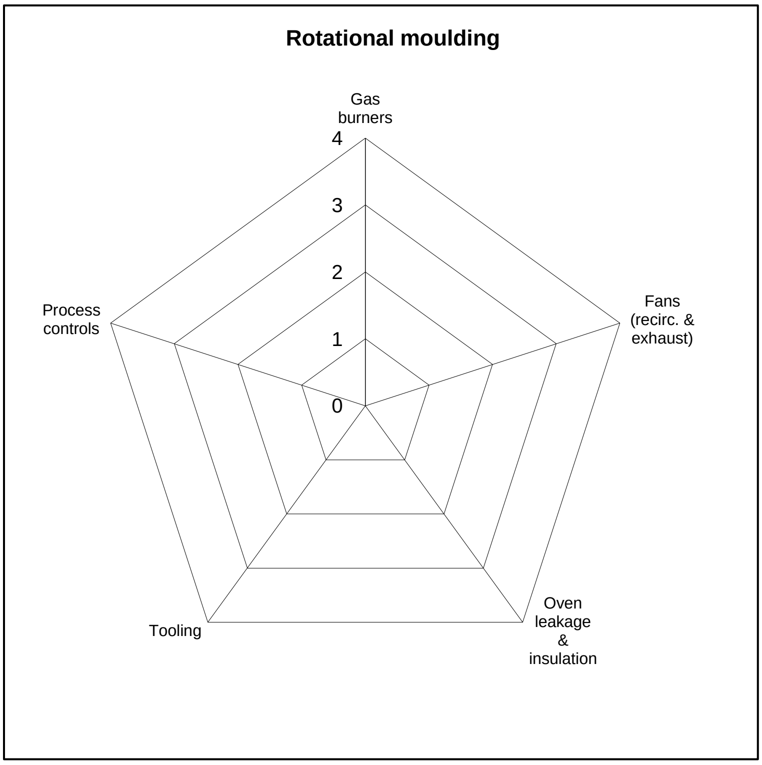
7. Rotational moulding

The process for big enclosed products

As with the score charts shown earlier, this is a self-assessment exercise to allow a site to benchmark their current status in rotational moulding.

Rotational moulding is an energy-intensive process but recent work has greatly improved the potential for process control and improvement. The tools and techniques are now available to significantly reduce the energy and cycle times of the process and to transform the economics of rotational moulding. Some of these improvements are the simple application of existing tools such as VSDs and good insulation but others are more advanced process controls such as monitoring the internal air temperature of the mould. Sites need to examine all of these techniques to reduce energy use and remain competitive.

Scoring



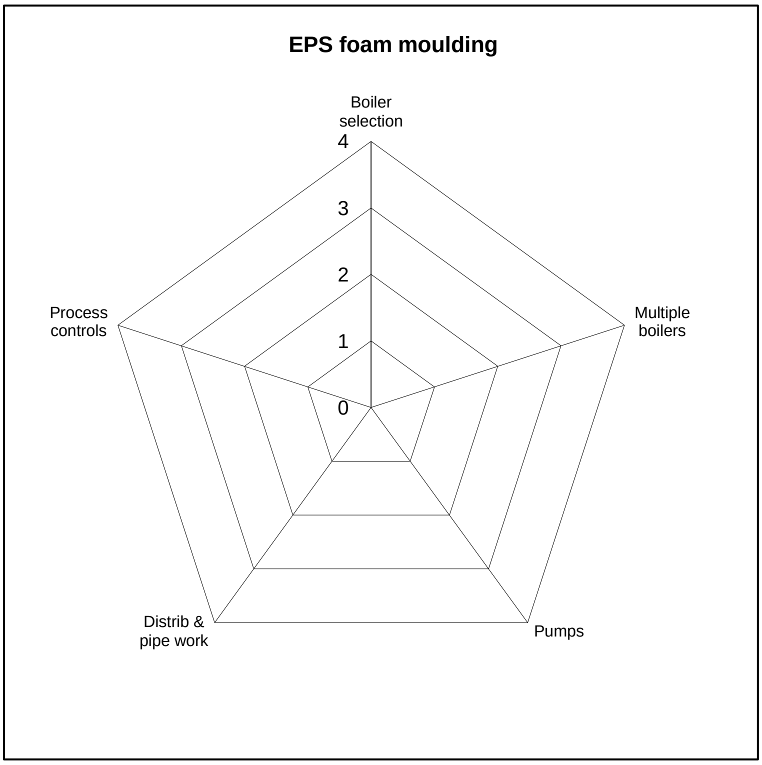
Processing - Rotational moulding					5.7
Level	**Gas burners**	**Fans (recirculation & exhaust)**	**Oven leakage & insulation**	**Tooling**	**Process controls**
4	Burner effectiveness automatically controlled for full combustion. Regular preventative maintenance. New burner technology & techniques investigated	Variable speed drives on all fans to optimise fan operation.	Minimal oven leakage. Excellent insulation of ovens. Regular thermographic surveys carried out to identify changes in leakage or insulation.	All tooling is aluminium or thin sheet steel for reduced thermal mass.	Cycle optimised for all products to minimise door/oven movement & opening times. Process optimised to minimise heat losses during the cycle.
3	Regular manual flue gas measurement. Gas burners rarely examined or cleaned. Burner maintenance on long maintenance cycle.	Variable speed drives control recirculation fans to optimise fan operation. Fixed speed exhaust fans operate w hether needed or not.	Minimal oven leakage. Good insulation of ovens. Sporadic thermographic surveys carried out to identify changes in leakage or insulation.	Most tooling is aluminium or thin sheet steel for reduced thermal mass. Programme in place to upgrade remaining tooling to reduce thermal mass.	Optimisation of cycle to minimise door/oven movement & opening times undertaken for majority of products. Reduced heat losses during the cycle.
2	Regular manual flue gas measurement. Gas burners rarely examined or cleaned. Burner maintenance on long maintenance cycle.	Fixed speed recirculation fans controlled by machine cycle. Variable speed drives control exhaust fans depending on conditions.	Moderate oven leakage. Moderate insulation of ovens. No thermographic survey carried out to assess oven performance.	Some tooling of reduced thermal mass & some of high thermal mass. No action being taken to upgrade tooling to reduce thermal mass.	Optimisation of cycle to minimise door/oven movement & opening times undertaken for minority of products. Moderate heat losses during the cycle.
1	Flue gas measurement rarely made. Gas burners rarely examined. Burner maintenance on breakdow n only.	Fixed speed motors on all fans controlled by machine cycle.	High oven leakage at several areas. Poor insulation of ovens. No thermographic survey carried out to assess oven performance.	Most tooling is solid steel & has high thermal mass. No action being taken to upgrade tooling to reduce thermal mass.	Optimisation of cycle to minimise door/oven movement & opening times considered but little action taken. High heat losses during the cycle.
0	No concept of flue gas measurement. Gas burners in 'as installed' state. Poor burner maintenance.	Fixed speed motors on all fans & operating w hether required or not.	Excessive oven leakage at many areas. Very poor insulation of ovens. No thermographic survey carried out to assess oven performance.	All tooling is steel & has high thermal mass. No action being taken to upgrade tooling to reduce thermal mass.	Optimisation of cycle to minimise door/oven movement & opening times not considered. Very high heat losses during the cycle.
Score					

8. EPS moulding

The white stuff

EPS foam moulding is unique in plastics processing in the use of steam as the major process energy use. As for any service, this must be managed (minimise the demand and then optimise the supply). Steam management a major task in reducing energy use in EPS moulding. This is not a skill normally associated with plastics processing but can make all the difference with EPS foam moulding.

Scoring



Processing - Expanded foams					5.8
Level	**Boiler selection**	**Multiple boilers**	**Pumps**	**Distribution & pipe work**	**Process controls**
4	Very low standing loss boilers – typically less than 0.5% of rated output.	All items below are satisfied & formal documentation exists on design intent & control settings.	Variable speed controlled from representative load, reducing pump differential pressure with demand. Records kept of pump control & operation.	All pipe work insulated at all areas (straight sections & valve areas) & well sealed. Distribution system in excellent condition. All redundant spurs isolated.	Excellent monitoring & control of steam quality & use. Heat exchangers used to recover heat where applicable. Excellent control of heat use.
3	Low standing loss boilers with losses down to 0.75% of rated output, common primary pump.	Heat losses from idle boilers are automatically minimised by reducing or restricting the water flow through boilers that are not firing.	Variable speed controlled from representative load, reducing pump differential pressure with demand.	Most straight pipe work insulated. Distribution system in very good condition. All redundant spurs isolated.	Good monitoring & control of steam quality & use. Several heat exchangers used in system. Good control of heat use.
2	High standing loss boilers with losses in the range of 2% to 5% of rated output, fully isolated & cold when off line.	Boiler operation dictated by automatic sequence controls. Redundant capacity capable of manual isolation.	Variable speed pumps controlled at constant pump differential pressure. Records kept of pump control & operation.	Some straight pipe work insulated. Distribution system in good condition. Few redundant spurs that are not isolated.	Some monitoring & control of steam quality & use. Some heat exchangers used in system. Good control of heat use.
1	High standing loss boilers with losses greater than 5% of rated output, isolated & cold when off line.	Conditions can be manually altered to change boiler sequencing.	Variable speed pumps controlled at constant pump differential pressure.	Pipe work is uninsulated. Distribution system in poor condition (visible distortion & corrosion). Some redundant spurs with no isolation.	No monitoring or control of steam quality & use. Some heat exchangers used in system. Good control of heat use.
0	High standing loss boilers greater than 7% of rated output, not isolated when off line.	Operation of multiple boilers does not change with changes in demand – warm return water is circulated through idle boilers & flow rates are constant.	Constant speed pumps.	Pipe work is uninsulated & shows leakage. Distribution system is old & has many sharp bends & corners. Many redundant spurs with no isolation.	No monitoring or control of steam quality & use. No heat exchangers used at any point in system. Poor control of heat use.
Score					

Part 6: Operations

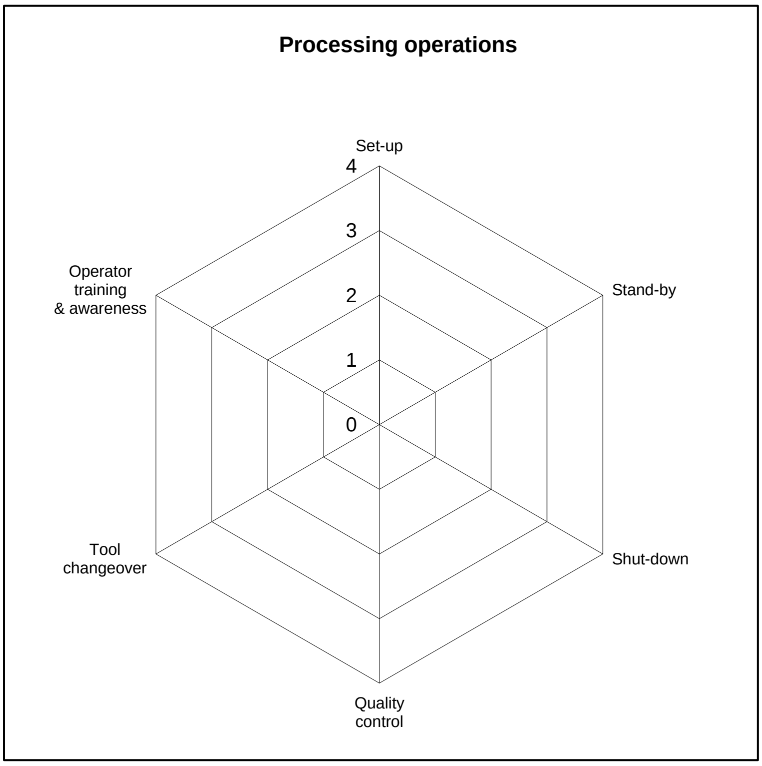
1. Processing operations

Every pellet in a product

As with the score charts shown earlier, this is a self-assessment exercise to allow a site to benchmark their current status. This will set the scene for planning improvements in the area of processing operations.

How sites are run, in human terms, is naturally important in terms of energy management. Simple rules for managing the operations can ensure that energy use is reduced considerably. This is real management of the process and gaining control of the process through management action. In far too many plastics processing sites, the weakness of the management is reflected in excessive energy use.

Scoring



Operations - Processing operations						6.1
Level	**Set-up**	**Stand-by**	**Shut-down**	**Quality control**	**Tool changeover**	**Operator training & awareness**
4	Set-up sheets available to all staff, sheets used to start machines. Sheets updated regularly with latest data.	Minimal stand-by operation. Machines switched off on job completion unless next job is ready to start. Data sheets for stand-by settings available & used.	Shut-down sheets available to all staff, sheets used to shut-down machines in energy-efficient manner. Sheets updated regularly with latest data.	Full SPC systems implemented. Capability studies carried out before project start. Control charts used for critical parameters.	OTED implemented.	Excellent operator training (general & job-specific). Structured general training & certification to national standard & internal job-specific training.
3	Set-up sheets available but use is restricted & some are out of date.	Stand-by instructions available to operators but more management action needed to enforce implementation.	Shut-down sheets available but use is restricted & some are out of date.	Limited SPC on specific products for specific customers. SPC carried out as a duty or customer service rather than as a normal part of the operations.	SMED implemented.	Extensive job-specific training for operators but little structure & most is ad-hoc.
2	Set-up sheets available but use is optional & many out of date.	Stand-by instructions available in theory but little concrete management action taken to enforce in operations.	Shut-down sheets available but use is optional & many out of date.	Complex 'end of line' inspection used (AQL approach). Limited attempt to gain control of the process.	Set-up time not relevant for most products (constant running) or set-up time reduction carried out to basic level for majority of products.	Moderate ad-hoc job-specific training for majority of operators.
1	Set-up sheets held by management & not used by setters. Many out of date.	No information on stand-by operations available. Some machines are switched off but most on stand-by for no apparent reason.	Shut-down sheets held by management & not used by setters. Many out of date.	Simple 'end of line' inspection. Quality based on rejecting the bad rather than controlling the process to prevent production of bad products.	Set-up time reduction carried out to basic level for minimal number of products.	Limited ad-hoc job-specific training carried out for some operators.
0	No setup sheets available or used.	No information on stand-by operations available. All machines set to 'stand-by' or left operational when not being used.	No shut down sheets available or used.	No visible inspection.	No consideration of changeover time reduction. EBQ dominates production thinking but no action taken to reduce.	No structured operator training available in either general or job-specific topics. Training uses the 'sit by Nellie' approach.
Score						

2. Small power equipment

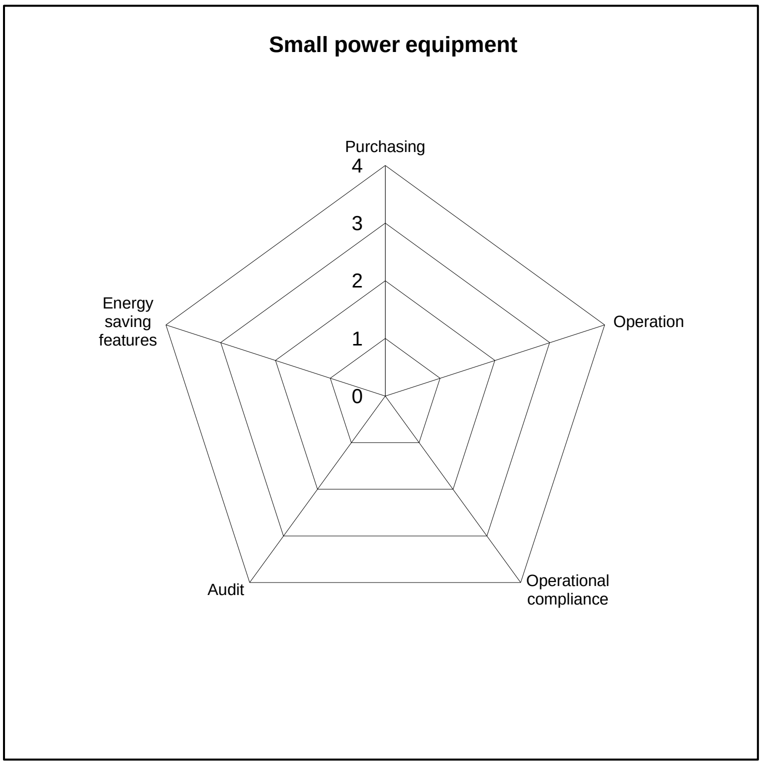
They may be small but they still use a lot

In seeking to improve management of the main plastics processing machinery it is very easy to overlook all the other small power equipment that is inevitably located throughout the site. Typical examples are:

- Ancillary equipment that is not part of the main processing lines.
- Test equipment throughout the site.
- Test equipment in the QC laboratory.
- Equipment and machines in maintenance workshops and tool rooms.

Small power equipment is everywhere in the factory and often overlooked despite the considerable amounts of energy that it uses and the easy savings potential of simple management techniques.

Scoring



Operations - Small power equipment					6.2
Level	**Purchasing**	**Operation**	**Operational compliance**	**Audit**	**Energy saving features**
4	Equipment selected to be the most appropriate to the application, bearing in mind life cycle costs & energy efficiency. Energy-saving features a major consideration in product selection.	Initial & regular assessment to determine most energy-efficient operating mode commensurate with business needs. Time switches & other devices installed where appropriate.	Regular checking of time switches & automatic controls to ensure equipment powered down to lowest consumption mode whenever possible.	Documented routine of regular checks to ensure equipment only powered up when necessary.	All energy-saving features (e.g., automatically reverting to standby after pre-determined time) are enabled & optimised.
3	Equipment selected to be energy-efficient. High energy-label products selected (where appropriate). Energy-saving features taken into consideration in product selection.	Initial assessment of each situation to determine the most energy-efficient operating mode commensurate with business needs.	Equipment only switched on when needed. Power-saving set-ups employed whenever possible to minimise waste.	There is a routine of regular checks to ensure equipment only powered up when necessary.	All energy-saving features are enabled & reviewed against likely criteria for efficient operation.
2	Equipment selected to be suitable for the application, bearing in mind life cycle costs & energy efficiency.	Departmental responsibilities exist for ensuring that equipment is switched off when not in use.	Equipment switched off when not needed.	Checks regularly carried out to determine whether equipment is switched off out of hours.	Energy savings settings are enabled for equipment with high electricity consumption.
1	Power efficiency data on products obtained as part of selection process.	Users instructed to only have equipment switched on when required.	All equipment switched on at start of day & remains on whenever building occupied.	Ad hoc checks carried out to determine whether equipment is switched off out of hours.	Some energy-saving features are enabled but there is no clear strategy, & settings are ad hoc & diverse.
0	No consideration of energy efficiency in product selection.	No policy for ensuring equipment switched off when not in use.	Equipment frequently left running even when building unoccupied.	No checks to determine whether equipment is left on even when building is unoccupied.	Pre-delivery settings are unchanged by users.
Score					

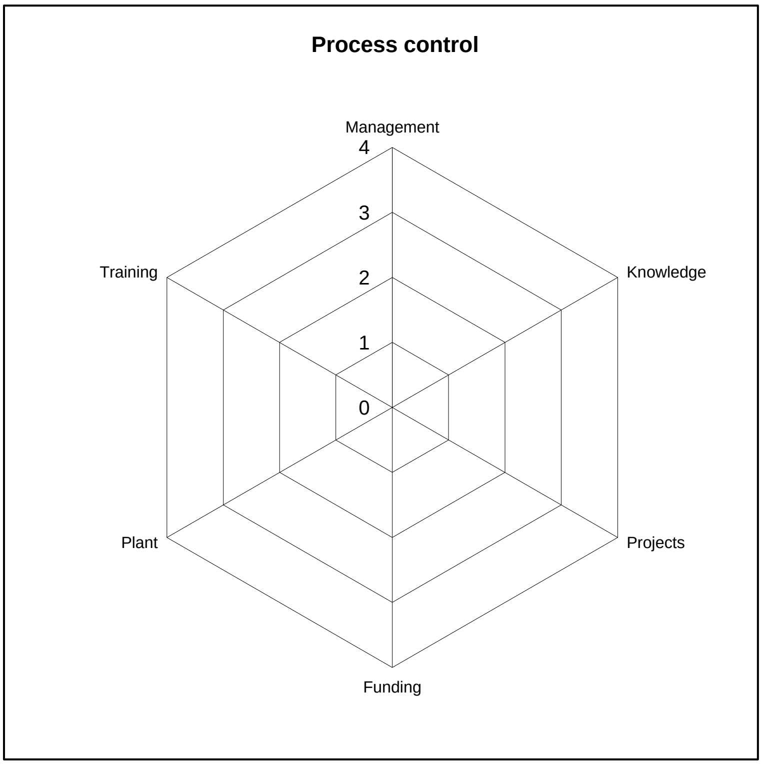
3. Process control

Control the process and you control the product

Process control is all about using the best available control techniques for machinery and processing control. The range of control techniques has improved dramatically in the recent past and sites that are not taking advantage of these improvements will inevitably be inefficient in their use of energy.

Improved process control allows better tuning of equipment to produce the required output at the least possible cost.

Scoring



Operations - Process control						6.3
Level	**Management**	**Knowledge**	**Projects**	**Funding**	**Plant**	**Training**
4	Process control improvement policy has top management commitment as part of improvement strategy.	Benefits of process control improvement are appreciated & supported at top management level.	Benefits analyses carried out frequently & regularly updated. Profit opportunities identified, costed & ready to proceed.	Improvement projects compete equally with other investments. Account is taken of benefits with no direct cost return, e.g., environmental.	Majority of plant incorporates best practice process control, correctly commissioned & well maintained. Problems rectified quickly.	Training provided for all technical & operating staff.
3	Process control improvement policy available with senior management responsible.	Senior management support present for process control improvement.	Experienced staff or consultants conduct process control improvement surveys of plants most likely to yield largest savings.	Projects compete for capital funding with other business opportunities, but have to meet stiffer investment returns.	Some more advanced control systems & action taken for most problems identified.	Some control awareness & process control improvement training for staff.
2	Process control improvement policy set by local management.	Middle management is responsible for process control improvement.	Infrequent monitoring to identify possible savings.	Control improvements are only considered with payback of 6 months, or less.	Control systems are simple but well maintained.	Technical staff development is mainly via professional & technical journals.
1	Control improvement is a part-time responsibility of someone with limited authority & influence.	Limited In-house knowledge of process control.	Surveys of process control effectiveness are rarely made.	Revenue funding only on low risk projects with short-term returns.	Control systems not best for efficient operation. Budget limits restrict improvement.	Few staff have knowledge of process control techniques.
0	No policy or delegation of responsibility for improvement.	No in-house expertise in control. Contracted out maintenance.	No resources available to identify profit opportunities.	No funding for process control improvement.	Breakdown maintenance only.	No training available for staff in process control.
Score						

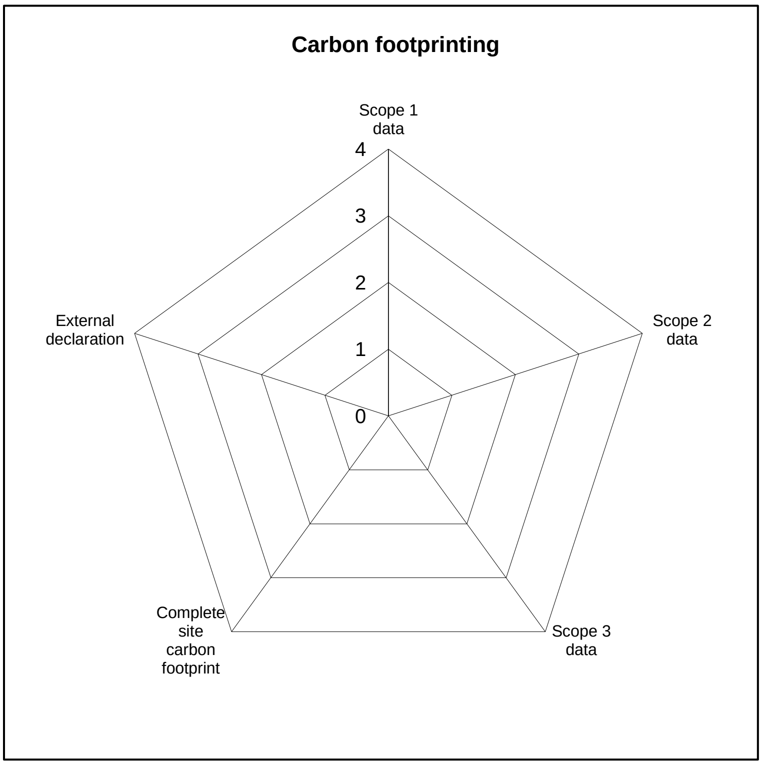
4. Carbon footprint

Assessing the impact

Carbon footprinting assesses the impact that a site or organisation has on the atmosphere and is a performance metric that is growing in importance. External organisations are increasingly asking suppliers for access to carbon footprint calculations and every site should be assessing this impact.

Good energy management for plastics processing companies will not only reduce the amount of energy used and the cost of this but will also reduce the carbon footprint. Companies may embark on energy management primarily for the cost benefits but calculating and monitoring the carbon footprint will also reveal the benefits to society of good energy management.

Scoring



Operations - Carbon footprint					6.4
Level	**Scope 1 data**	**Scope 2 data**	**Scope 3 data**	**Complete site carbon footprint**	**External declaration**
4	All relevant Scope 1 data collected on a monthly basis using existing accounting systems for greater accuracy.	Scope 2 emissions from electricity calculated using supplier's current specific carbon intensity for generation.	All relevant Scope 3 data collected on a regular basis using existing accounting systems for greater accuracy.	All relevant data for Scopes 1 to 3 combined on a monthly basis using existing accounting systems for greater accuracy.	Full external declaration of organisation carbon footprint for Scopes 1 to 3.
3	All relevant Scope 1 data collected on an annual basis using existing accounting systems.	Scope 2 emissions from electricity calculated using area or region carbon intensity for generation.	All relevant Scope 3 data collected on an annual basis using existing accounting systems.	All relevant data for Scopes 1 to 3 combined on an annual basis using existing accounting systems.	Full external declaration of site carbon footprint for Scopes 1 to 3.
2	All relevant Scope 1 data estimated on an annual basis.	Scope 2 emissions from electricity calculated using general country carbon intensity for generation.	All relevant Scope 3 data estimated on an annual basis.	All relevant data for Scopes 1 to 3 combined on an annual basis using good estimates for a number of factors.	Full external declaration of organisation carbon footprint for Scopes 1 & 2.
1	Some relevant Scope 1 data not calculated at all.	Scope 2 emissions from electricity calculated using unvalidated carbon intensity factor for generation.	Some relevant Scope 3 data not calculated at all.	Scope 1 & 2 data combined for partial carbon footprint but no Scope 3 data estimated or included.	Full external declaration of site carbon footprint for Scopes 1 & 2.
0	No calculation of Scope 1 data.	No calculation of Scope 2 data.	No calculation of Scope 3 data.	No complete site carbon footprint prepared.	No external declaration of organisation or site carbon footprint.
Score					

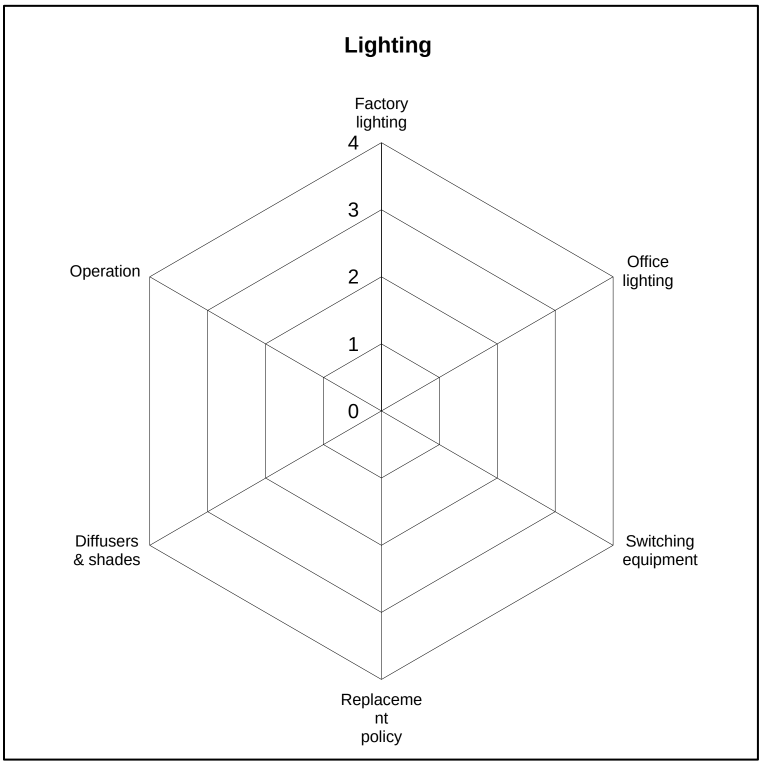
Part 7: Buildings and offices

1. Lighting

I can see clearly now

Lighting is a difficult topic to assess due to the widely varying needs of different areas. Offices require an entirely different lighting strategy to factories because of the greatly different needs. The assessment is broad-ranging but deals primarily with installing lighting that can be adequately controlled to provide the right lighting levels at the lowest possible overall cost to the site. Lighting is also an extremely emotive subject – staff are interested in the very visible commitment that a company will make in terms of lighting but will also vigorously challenge any changes that are made that appear to reduce lighting levels.

Scoring



Buildings and offices - Lighting — 7.1

Level	Factory lighting	Office lighting	Switching equipment	Replacement policy	Diffusers & shades	Operation
4	Factory lighting with fully controlled 16 mm triphosphor coated T5 tubes or LEDs.	All lights are 16 mm diameter (T5) tubes or LEDs.	Lights are switched in banks & switches match activity & daylight. Switches are labelled to show which lamps they operate.	Light fittings, including diffusers, reflectors & ballasts, are updated on a planned basis. Specular reflectors are widely used.	Diffusers & shades are selected for their high utilisation factor & are cleaned on a scheduled basis.	Lights operate only as required. Where daylight is available, lighting is adjusted to requirement. Routine exists for regularly checking lighting use.
3	High pressure sodium lamps used throughout due to no need for good colour rendering. Task lighting used when good colour rendering is needed.	Mix of 16 mm diameter (T5) tubes & 26 mm diameter (T8) tubes.	Lights are switched in separate rows & switches located near the lights they operate. Switches are clearly labelled.	Light fittings, including diffusers, reflectors & ballasts are periodically upgraded when opportunities allow.	Diffusers & shades are selected for their high utilisation factor & are cleaned occasionally.	Lighting levels & hours of operation are well controlled. Checks are undertaken on an ad hoc basis. Cleaners light current working area only.
2	High pressure metal halide used throughout due to need for good colour rendering.	All lights are 26 mm diameter (T8) tubes.	Lights are switched in rows & switches located near the lights they operate. Rows not aligned with daylight, switches not labelled.	Light fittings, including diffusers, reflectors & ballasts are upgraded on an ad hoc basis.	Diffusers & shades are of high utilisation factor, but are not regularly maintained.	Lighting levels partially controlled. Lights are switched on when they are required, & switched off when not. No routine for checking use.
1	High pressure mercury lamps used throughout.	Mix of 26 mm diameter (T8) tubes & 38 mm diameter (T12) tubes.	Lights have the potential to be switched on in banks, but in practice all go on together.	Lamps & ballasts are sometimes upgraded to high-efficiency types when they are replaced.	Diffusers & shades are of fair translucency but are rarely cleaned.	Lighting levels partially controlled. Lights switched on at start & operate continuously when building occupied, whether needed or not.
0	Tungsten halogen or tungsten filament lighting throughout.	All lights are 38 mm diameter (T12) tubes.	Lights are switched from central locations & all go on together.	Lamps are replaced upon failure with 'like-for-like' lamp types.	Diffusers & shades are not selected for translucency / light transmitting properties. There is no programme for cleaning.	Lighting levels are uncontrolled. Lighting is frequently left on 24 hours per day whether the building is occupied or not.
Score						

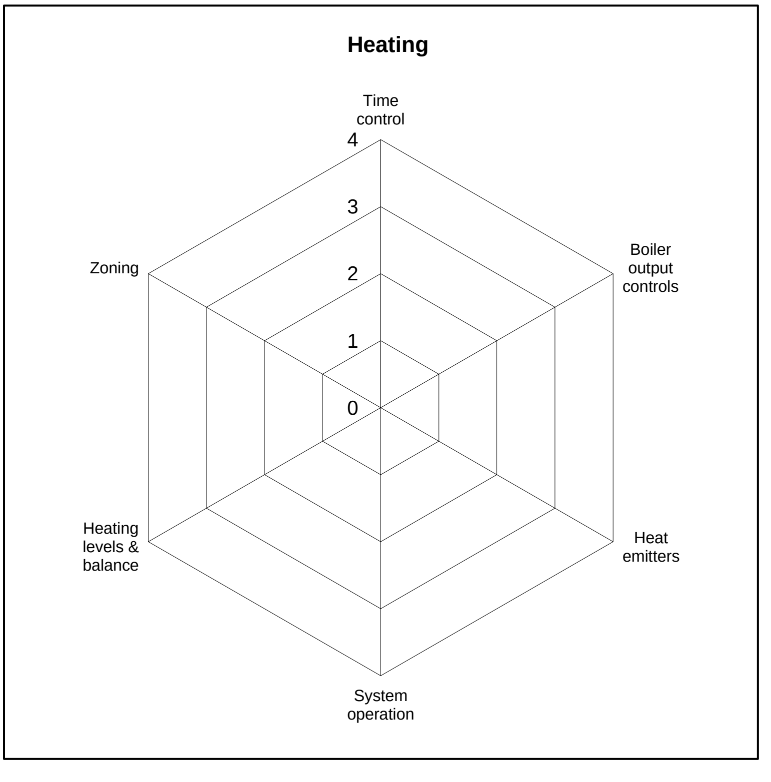
2. Space heating

Controls are vital

In plastics processing, heating the production area is relatively low cost but heating the offices and other areas is often inefficient and poorly controlled. Improved controls and distribution can often pay good dividends in reducing energy use.

Personal comfort is important but there is no reason for everybody in the office to come to work in polo shirts just because somebody else is paying the bill – they don't do this at home, so why should they expect you to pay the bills for them to do this at work!

Scoring



Buildings and offices - Space heating						7.2
Level	**Time control**	**Boiler output controls**	**Heat emitters**	**System operation**	**Heating levels & balance**	**Zoning**
4	Space heating is controlled by system programmed for non-working days & with self-learning optimum start & stop.	Effective automatic control of boiler standing losses. Only required boilers are hot, all others cold or cooling. Boilers & manifolds well insulated.	Radiators have thermostatic valves, fan convectors have individual controls & different areas of the building have internal thermostats.	Rigorous checking of controls function, settings & system balance annually. Documented procedures & results recorded.	Temperatures are even throughout the building (18°–20°C) when occupied, otherwise reducing to lower temperatures.	Zoning for occupancy, solar gain, equipment gain, structure, etc, where appropriate. Adequate means for controlling temperature in each zone.
3	Optimum start controller varies start time of heating from outside temperatures & optimum stop at the end of the day.	Effective manual isolation of boilers to reduce standing losses when full output is not required. Boiler & manifold well insulated.	Radiators & fan convectors have individually operated controls. Temperature of radiators varies with the season.	Full yearly check of controls, settings & system balance. Documented procedure for each check. Some results recorded.	Temperatures are even throughout the building, but in some parts they are > 20°C during spring or autumn. 20°C maintained only during occupancy.	Extensive zoning, approximately reflecting occupancy time & temperature requirements. Controls exist for each zone.
2	Optimum start controller fitted to the heating system. Holiday periods can be programmed in advance.	Boilers become hot only when boiler output is required. Boilers are cold at all other times (e.g. overnight).	Radiators have individual controls but water temperature is the same all year round.	Informal checking of controls & system balance carried out once per year. Schedule exists but no records.	Temperatures are > 20°C during spring & autumn, & the building is warm for more than an hour before or after occupancy.	Limited zoning, due to building expansion, but zones approximately reflect the need for distinct occupancy times & temperatures.
1	Heating system has an easily set simple timer. Timer settings are adjusted manually to suit season.	Boilers remain hot during pre-heat & building occupation hours during summer & winter.	Radiators have basic controls & there is only one internal temperature sensor to control them.	Annual functional checks carried out but not recorded.	Temperatures vary & they are frequently > 20°C for long periods – including periods of no occupancy.	Limited zoning or inappropriate zoning.
0	Timer in poor state of repair & cannot be easily adjusted. The controller does not recognise days of the week.	Boilers remain hot regardless of whether or not there is a demand for heating.	Radiators have no controls & get hot together. Radiator temperatures appear to be the same all year round.	Maintenance is on breakdown basis & controls are checked only when problems occur.	Building temperatures are frequently too hot for much of the building, particularly in spring & autumn.	No zoning.
Score						

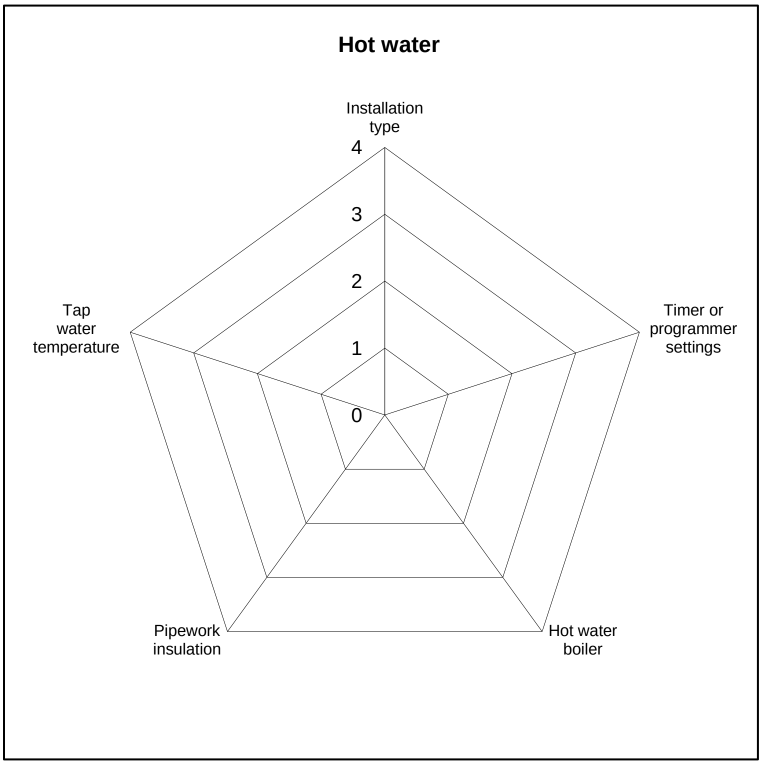
3. Hot water

It is mostly for washing

Most hot water use in plastics processing is for personal use and process use is generally low. Despite this, hot water can be quite costly and the chance to reduce energy use and costs by simple good practice should not be missed.

As with lighting and heating, the use of good controls is a key to minimising hot water costs – delivery of the correct amount of water at the correct temperatures is all that is required.

Scoring



Buildings and offices - Hot water (personnel) — 7.3

Level	Installation type	Timer settings	Hot water boiler	Pipework insulation	Water temp.
4	Instantaneous point of use water heaters or water heaters with localised storage & time controls.	Two or more visual & functional checks made each year against a formal document & results recorded. No pump or heating fuel used when building is unoccupied.	The hot water boiler is correctly sized, appropriately located & designed to eliminate stratification. Insulated to the optimum thickness.	All pipework is well insulated & both insulation & reflective coatings or waterproof finishes are in prime condition. Flanges, valves & other fittings are insulated.	Water circulation temperatures are hot throughout (> 50°C) & where there is risk of scalding, outlets are fitted with blenders to mix with cold water for comfort.
3	Instantaneous point of use water heaters or water heaters with localised storage without time controls.	Annual visual checks made using formal procedures & results recorded. No pump power or heating fuel used when building is unoccupied.	Hot water boiler is correctly sized & insulated to an economic thickness calculated using local criteria. Located to meet demand for hot water.	All pipework in both unheated & heated spaces is well insulated & insulation feels cool to the touch. Flanges, valves & other fittings are insulated.	Water circulation temperatures are hot throughout (> 50°C) & some automatic blenders are fitted to mix with cold water for comfort.
2	Hot water is provided from dedicated central plant with seven-day timer/programmer that allows heating & hot water services to operate independently.	Times of availability closely matched to demand. Regular checks on time switch settings.	Hot water boiler is well insulated with insulation known to be more than 50 mm thick.	All pipework in both unheated & heated spaces is well insulated & insulation feels cool to the touch.	Water circulation temperatures are hot throughout (> 50°C). Water temperature at the taps is hand hot & cold water has to be added regularly for comfort.
1	Hot water is provided from central plant, with timer/programmer serving both heating system & hot water.	Times of availability not specifically checked.	Hot water boiler is insulated with 25–50 mm insulation.	Pipework in unheated spaces is well insulated & cool to the touch.	Water temperature at the taps is variable & is often < 50°C or > 60°C.
0	The only controls are on/off & the primary circuit thermostat.	Times of availability not specifically checked. Strong possibility of availability when building unoccupied.	Hot water boiler is incompletely insulated & is subject to significant heat loss.	Pipework generally is not insulated or the insulation is thin, damaged or in poor condition.	Water temperature at the taps is regularly < 50°C or > 60°C.
Score					

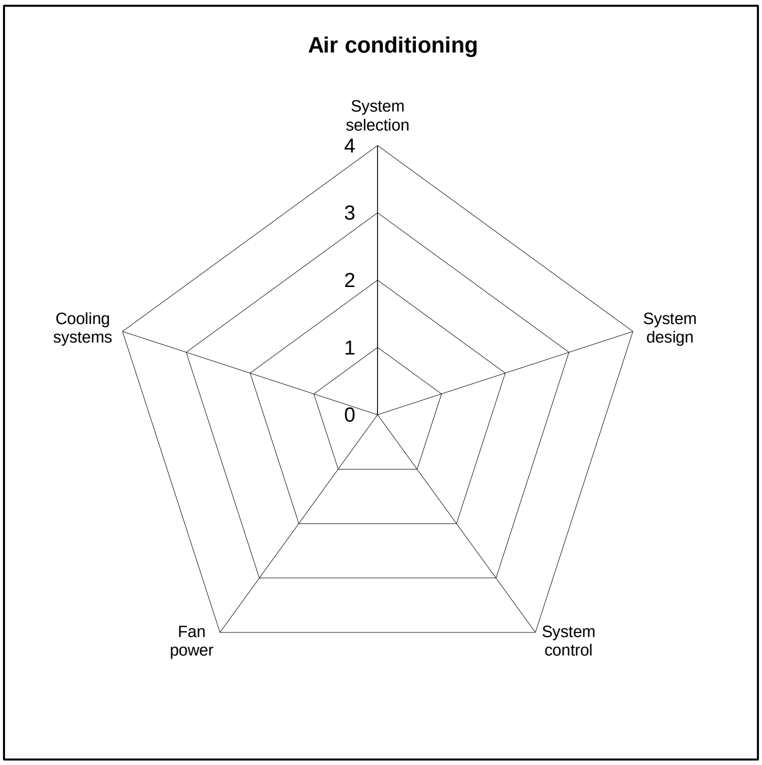
4. Air conditioning

An expensive cool breeze

As with the score charts shown earlier, this is a self-assessment exercise to allow a site to benchmark their current status. This will set the scene for planning improvements in air conditioning.

Air conditioning is a rapidly rising cost throughout the world and equally so in the plastics processing industry. Hot production areas often lead to air-conditioned offices immediately adjacent to hot machines. Energy management in air conditioning is a combination of good controls and staff management to ensure that air conditioning is cooling the minimum volume for the minimum time. Air-conditioned areas should always have controlled access and self-closing doors should be fitted to avoid inadvertent 'cooling' of the production area.

Scoring



Buildings and offices - Air conditioning — 7.4

Level	System selection	System design	System control	Fan power	Cooling systems
4	Appropriate system with delivered air volumes to match need. System includes energy-saving features such as heat recovery or controlled partial recirculation based on air quality	System design well matched to needs & building type. Temperature & humidity controlled with minimum energy consumption.	Wide deadband for control setpoints for temperature & humidity (where apropriate). Occupancy-based control with good operator facilities.	High-efficiency fans selected used & system designed for low pressure loss along ductwork. Control by VSD.	Efficient means for providing cooling. Chillers have variable speed compressors. Flow rates and/or temperature of cooling medium is variable depending on demand.
3	Appropriate system with carefully delivered air volumes to match the need. Energy-saving features such as run-around coils for heat recovery.	Good system design with all expected energy efficiency measures, such as free cooling control & night purge during summer. Temperature & humidity requirements achieved	Automatically controlled but variable conditions for common supply ducts. Modern electronic controls. Communication between controllers.	Good fan selection & good ductwork design. System uses VSD and/or high-efficiency motor.	Efficient means for cooling, e.g., good use made of evaporative cooling. Chillers selected & sequenced to match demand across load range.
2	Air-conditioning necessary but inappropriate systems and/or features selected. Excessive air change rates & unnecessary cooling or humidity control.	Designed to reasonable standard but lacks energy efficiency other than limited measures, e.g., free cooling control.	Fixed common supply duct conditions to limit duty on terminal units but no optiisation of energy performance. Modern controls with time programming.	Reasonable fan selection & ductwork design, but energy efficiency was not a prominent factor during selection.	Cooling provided using efficient chillers. Outputs chosen to minimise energy consumption, particular over the full range of operating loads. Fixed delivery temperature
1	Air-conditioning necessary for parts of building but other areas are air-conditioned.	Poorly designed & oversized plant with lack of energy efficiency measures such as free cooling control. Reasonable functional control of plant.	Very close control of heating & cooling. Stand-alone time control without facility for shut-down during unoccupied periods.	Oversized fans or poor ductwork design.	Reasonable chiller performance, but poor performance characteristics at low operating loads. Fixed delivery temperature, lower than required.
0	Air-conditioning not necessary, yet presence is significant.	Very poor design & likely to be oversized for application. No energy-saving features.	Close control of heating & cooling in space & within supply ducts (to within less than 1°C, 5% RH) where not appropriate. Poor time control of plant.	Oversized, poorly selected fans, poor ductwork design.	Poor chiller performance, providing a constant temperature output, at a much lower level than necessary.
Score					

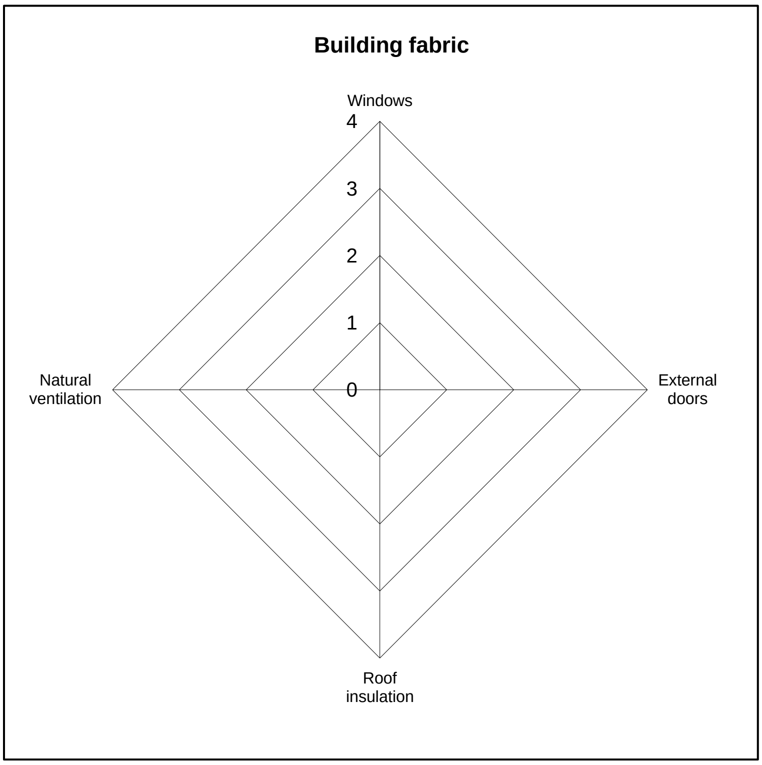
5. Building fabric

The built environment

As with the score charts shown earlier, this is a self-assessment exercise to allow a site to benchmark their current status. This will set the scene for planning improvements in the area of building fabric.

The condition of the building fabric controls the use of both heating and air conditioning and a high-quality building fabric can minimise both costs. The energy efficiency of the building fabric has increased dramatically in the recent past as developers and owners have recognised the need to decrease the energy use in buildings. Many of the older buildings in the plastics processing industry could be cost-effectively overhauled to improve comfort and convenience and at the same time reduce energy use.

Scoring



Buildings and offices - Building fabric — 7.5

Level	Windows	External doors	Roof insulation	Natural ventilation
4	All windows double glazed & draughtstripped. Window operating gear holds them tightly shut.	All external doors draughtstripped with operating self-closing devices. Draught lobbies provided for frequently operated doors.	Roof insulation is at least 150 mm thick & continuous over whole roof area.	Users have control over ventilation, providing adequate ventilation during occupancy. Much reduced overnight & weekend ventilation serving only to prevent condensation.
3	All windows double glazed & draughtstripped.	Most external doors are well-fitting & draughtstripped with operating self-closing devices. Door locks hold them tightly closed.	Roof insulation is at least 100 mm thick & continuous over whole roof area.	Reasonable degree of user control over natural ventilation. Adequate ventilation during occupancy, with significantly reduced air changes outside of working hours.
2	Windows generally single glazed & draughtstripped. Window operating gear holds them tightly shut.	External doors well-fitting & generally draughtstripped.	Roof insulation is 150 mm to 100 mm thick generally, but visible gaps in the insulation.	Some degree of user control over ventilation rates during occupancy, although excessive during winter & inadequate during summer.
1	Windows single glazed but fit well with minimal draughts.	External doors fit well.	Parts of the roof are insulated.	Higher than necessary rates of ventilation during occupied periods, with minimal reduction outside of occupancy.
0	Windows single glazed & poorly fitting with gaps visible around the edges.	External doors are poorly fitting & gaps are visible around the edges.	There is no roof insulation installed.	Unnecessarily high air change rates with no variation between air change rates inside & outside of occupancy.
Score				