Victorian Energy Upgrades Proposed Activity

Hot Pipe Lagging Issues Paper

OFFICIAL

Author

This document has been prepared by the Department of Environment, Land, Water and Planning.

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Acknowledgment

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partner, and meaningfully engage, with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.

Accessibility

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Overview

About the Victorian Energy Upgrades (VEU) program

The Victorian Energy Upgrades (VEU) program is established under the *Victorian Energy Efficiency Target Act 2007* to help Victoria reduce its greenhouse gas emissions, reduce the use of electricity and gas and invest in industries that provide energy demand management technology and services. The program provides subsidies for residential and business consumers to reduce their energy use by upgrading appliances, processes or buildings.

The VEU program works by creating financial incentives for households and businesses to undertake energy saving activities. When accredited businesses (known as accredited providers) undertake eligible energy efficiency improvements in homes or businesses, they create Victorian Energy Efficiency Certificates (VEECs). Each VEEC represents one tonne of greenhouse gas emissions saved over the lifetime of the activity or product installed. VEECs can then be sold to energy retailers who must meet an emission savings target each year based on their annual electricity and gas sales.

The VEU program includes energy saving activities for both households and businesses. Activities currently available for business in the program include lighting upgrades, installation of high efficiency motors, upgrades to gas-fired boilers, and energy efficiency projects whose impacts are measured through project-based activity methods (e.g. measurement and verification).

Purpose of the pipe lagging issues paper

The Department of Environment, Land, Water and Planning (the department) is looking at expanding the range of energy efficiency upgrades (activities) available under the VEU program and is seeking feedback from stakeholders on four potential new activities, including;

- upgrades to the refrigeration equipment of cold rooms
- installation of Energy Management Information Systems (EMIS) in commercial buildings
- upgrades to install lagging (insulation) on pipework for gas systems
- the installation of smart thermostats for residential heating and cooling systems.

The purpose of this document is to set out options to introduce the installation of lagging on pipework heated by gas-fired appliances as an activity in the VEU program and to seek the views of interested stakeholders.

Have your say

Stakeholders can submit their feedback on the four potential new activities using the **new activities consultation response template and/or the survey**, both available on the Engage Victoria website https://engage.vic.gov.au/victorian-energy-upgrades-new-activities-consultation. Please submit your feedback to the questions in the pipe lagging issues paper by completing the new activities consultation response template and/or the survey and uploading your submission to the Engage Victoria website. Feedback from stakeholder submissions will be used to guide the creation and implementation of the new VEU activities.

Submissions can also be emailed to energy.upgrades@delwp.vic.gov.au or sent as a hard copy submission to: *Victorian Energy Upgrades, Department of Environment, Land, Water and Planning, PO Box 500, East Melbourne, VIC 8002*. If you make a submission by email or post, please ensure to state whether the department can publish your submission.

This consultation will close on 5 February 2021.

Introduction

Heated pipes and energy consumption

Heated pipework is found in office buildings, hotels, hospitals, schools, apartment blocks, manufacturing, food processing, sanitisation and a variety of other commercial and industrial spaces. A fluid (often water) carried in the pipework is used to distribute heat from a heater or boiler throughout a facility. A significant amount of energy is required to heat the fluid distributed in the pipework. For example, in commercial buildings in Victoria, approximately 36 per cent[1] of the energy use is in the form of gas consumption, with this energy largely consumed in gas boilers to provide space heating or hot water. The proportion of energy devoted to gas usage is typically even higher in industrial facilities, where a major gas end use is due to boilers producing hot water, steam or other fluids.

Hot pipework systems deliver heated fluids from boilers or water heaters in one part of a facility to other areas. These systems can cover vast areas and large distances and be both indoors and outdoors. Without insulation (often referred to as 'lagging') these hot pipework systems act as uncontrolled radiant heating to the surrounding environment. This is often equivalent to 10-12 per cent[2,3] of the system's total fuel consumption. The application of effective pipe insulation or lagging for these systems is an important contributor to gas efficiency and can ensure significant energy savings.

Role of pipe lagging

Hot pipe lagging or pipe insulation involves wrapping pipework in material specifically designed to prevent heat transfer. The energy saving is achieved by reducing radiant and convective heat loss from the surface of the pipework. It is a simple and cheap way to reduce losses in any system with hot fluid reticulation. Correctly specified and installed insulation can reduce heat loss from the surface of a pipe by over 90 per cent[4]. Any measured or calculated savings in the field creates an added benefit by saving energy equal to the inefficiency in combustion at the boiler/heater. This means that the efficiency benefit at the energy source is increased, which for many gas boilers can be by 20 per cent[5]. Prevention of steam loss to condensation in pipework in steam systems not only saves a larger fraction of energy but can also save on maintenance costs.

The efficacy of lagging in reducing heat transmission is expressed as "R", which stands for the thermal resistance per unit area of insulation. This R value is assigned to the insulation product, which may include a single material or a selection of materials in sequence. The Plumbing Code of Australia specifies minimum lagging requirements for new hot water plumbing installations other than central heating systems by referring to AS/NZS 3500.4: *Plumbing and drainage Part 4: Heated water services*. This standard requires insulation with a thermal resistance of R-0.3 for internal pipework and R-0.6 for external pipework over most of Victoria. The National Construction Code (NCC) requirements for lagging on heated pipework for central heating systems in new buildings are R-1.7 for pipework maintained at 50-85°C and R-2.7 for pipework maintained above 85°C (NCC 2019). Other heated pipework applications do not have a specific legislated requirement for lagging and may choose to meet occupational health and safety requirements by preventing access using barriers. Neither the Plumbing Code of Australia nor the NCC requirements apply retrospectively to existing buildings, and the first requirements for lagging of hot pipework under the NCC (R-0.2 to R-0.8), were introduced in 2005. This means that much of the older hot pipework in Victoria may be completely un-lagged, while newer pipework may only have minimal lagging.

[1] Strategy Policy Research, October 2019, Electrification Opportunities in Victoria's Commercial Sector.

[2] Kent R (2018) *Energy Management in Plastics Processing (Third Edition) - Strategies, Targets, Techniques, and Tools*, pp.211-318.

[3] Vesterlund M, Sandberg J, Lindblom B, Dahl J (2013) *Evaluation of losses in district heating system – a case study*, Proceedings of Ecos 2013 – 26th international conference on efficiency, cost, optimization, simulation and environmental impact of energy systems, Guliin, China.

[4] National Mechanical Insulation Committee, last updated 30/1/2017, Whole Building Design Guide, accessed 14/4/2020 https://www.wbdg.org/guides-specifications/mechanical-insulation-design-guide/design-objectives/energy-calculator-horizontal-piping

[5] National Mechanical Insulation Committee, last updated 30/1/2017, Whole Building Design Guide, accessed 14/4/2020 https://www.wbdg.org/guides-specifications/mechanical-insulation-design-guide/design-objectives/energy-calculator-horizontal-piping

Industry discussions

Initial discussions with industry indicate that lagging is typically installed on any new pipework which maintains temperatures above 50°C, regardless of the end use. The commercial market typically replaces existing lagging at or past the point of failure. Commercial sites often choose to save on up-front cost by using thinner insulation or omitting cladding or protective layers required for weather and moisture protection. This results in early failure or lower installed thermal resistance than recommended. Lagging on valves or ports is often removed for access to the system during servicing and not replaced, resulting in heat leaking out at points in the system. Discussions with lagging installers have indicated that industrial sites schedules replacement of lagging before the end of life, often every five years.

This initial research suggests there may be a need for accelerating the retrofitting of lagging and of increasing the quality of lagging in commercial buildings in order to enhance energy efficiency. There does not appear to be the same need in industrial facilities.

Estimates of payback periods for installing pipe lagging on bare pipework are short relative to many other types of energy efficiency upgrades, often less than one year, and decrease with increasing pipe diameter and operating temperature[6]. Despite significant utility savings, many facilities do not lag heated pipework, or allow lagging to deteriorate until it is no longer effective. Reasons for this may be that the consequences of not installing or replacing lagging are often invisible.

Consultation questions:

1. Do you think our description of pipe lagging installation and replacement practices at **commercial facilities** (outlined above) is accurate?
   a. *Yes / No*
   b. Please explain your understanding of pipe lagging installation and replacement practices at **commercial facilities**.
2. Do you think our description of pipe lagging installation and replacement practices at **industrial facilities** (outlined above) is accurate?
   a. Yes / No
   b. Please explain your understanding of pipe lagging installation and replacement practices at **industrial facilities**.
3. Do you think insulating hot pipes has merit as a potential VEU activity?
   a. *Yes / No*
   b. Please explain your response.

[6] Hart G H, 2012, Saving Energy by Insulating Pipe Components on Steam and Hot Water Distribution Systems, https://insulation.org/io/articles/saving-energy-by-insulating-pipe-components-on-steam-and-hot-water-distribution-systems/

Hot pipe lagging as a potential VEU activity

Overview

The proposed activity is focused on reducing heat energy losses from reticulated pipework carrying fluid (liquids or gases) held at elevated temperatures by natural gas-fired appliances in order to improve overall gas efficiency. This is to be achieved by lagging heated pipework and associated valves and ports on new or existing hot pipework.

Standards

To introduce a new VEU activity, it is important to be able to clearly define what the activity entails and to be able to develop methods for predicting the probable energy saving from the activity. The use of industrial standards can be an important part of this definition process. There are a number of relevant standards for pipe lagging and insulation in general, including:

- AS/NZS 4859.1 *Thermal Insulation Materials for Buildings – General Criteria and Technical Provisions* and ASTM C 335/C335M *Standard Test Method for Steady-state Heat Transfer Properties of Pipe Insulation* details methods for determining the thermal resistance of different types of insulation and set out standards for material properties.
- AS 4426 *Thermal Insulation of Pipework, Ductwork and Equipment – Selection, Installation and Finish* sets out detailed descriptions of material selection, requirements for assembly and installation of lagging including mounting of lagged pipework, and the different types of finishing.

These standards are proposed to be used to define compliance with VEU lagging activities.

Potential VEU lagging criteria

Requiring a minimum warranty period for the work undertaken can be an additional way of ensuring that the quality of an activity is adequate. Lagging installers have indicated through informal discussion that although many businesses do not currently offer warranty periods, they are willing to consider this in the future. Some businesses said that they would be willing to offer lifetime warranty periods if required by VEU.

Using the above standards as the basis for the activity definition, the minimum features of lagging products in a proposed activity could include:

- a product or combination of products which produce a specified R value for pipework maintained at 50-85°C and for pipework maintained above 85°C when measured and declared in accordance with AS/NZS 4859.1 *Thermal Insulation Materials for Buildings – General Criteria and Technical Provisions* or ASTM C 335/C335M *Standard Test Method for Steady-state Heat Transfer Properties of Pipe Insulation*
- a product or combination of products that comply with the performance requirements of AS/NZS 4859.1 (which includes limits on moisture absorption, resistance to insects and mould and other requirements)
- selection of materials and finishing in line with recommendations for best practice provided in AS 4426 *Thermal Insulation of Pipework, Ductwork and Equipment – Selection, Installation and Finish*
- lagging for valves or port covers must be removable
- materials are covered against defects for a minimum of five years.

Correct installation is critical to make sure lagging works effectively and improves system efficiency. Minimum requirements for installation of lagging under the proposed activity could include:

- all lagging must be installed on pipework which carries fluid heated and maintained at an elevated temperature by a gas-fired appliance
- all lagging must be installed on pipework which is in working order, without visible leaks and with a remaining serviceable life of at least eight years

- application of materials, fixings/attachments, barriers, and finishing in line with recommendations for best practice provided in AS 4426 *Thermal Insulation of Pipework, Ductwork and Equipment – Selection, Installation and Finish*
- is covered against defects of materials and workmanship for a minimum of five years.

Consultation questions:

4. Do you think that AS 4426 provides a strong enough set of guidelines to ensure that only high quality, fit-for-purpose lagging installations are incentivised?
   a. *Yes / No*
   b. If not, which other standards would you recommend and why?
5. What do you think is a reasonable warranty period (installation and product) that could be put in place for high quality lagging installations without creating a barrier to the activity?
6. Are there other features that should be required as a minimum for the activity? (e.g. required cladding, or a maximum limit on thermal conductivity to ensure pipe diameter and hence heat loss area is not unnecessarily increased)

Energy savings and VEEC incentives

The proposed lagging upgrade activity will produce predictable energy savings and is considered suitable as a potential deemed VEU activity. This means that the emissions savings from the lifetime of the activity will be calculated and VEECs awarded after installation.

The energy saving that results from any specific pipe lagging activity will be dependent on a number of factors, so the calculation of the deemed energy saving will need to take these factors into consideration.

The most important factors needed to calculate savings from these activities and make sure energy and emissions are achieved are:

- the temperature pipework is maintained at (e.g. 50-85°C or temperatures above 85°C)
- pipe diameter (e.g. ≤100mm or >100mm)
- whether the pipework is located indoors or outdoors
- lineal metres of lagging and count of valve covers
- hours of operation.

Research for the deemed gas efficiency activities (Part 37-42) introduced into the VEU program in 2018 determined a conservative typical pattern of demand or “load utilisation factor” for both commercial and industrial gas boilers. This is expressed in hours and could be used as a conservative default load utilisation factor for all systems undertaking hot pipe lagging activities which cannot provide evidence of their annual system operation hours.

Because there are higher mandatory requirements for lagging of pipework which is part of a central heating system this application of pipework may be separated from others and receive less incentive.

Cost saving in most cases will result from installing lagging on new pipework or replacing lagging when installations are past the end of useful life. The relatively large potential for energy and emission savings means that the proposed activity could produce significant incentives to encourage the uptake and provide a cost-effective opportunity to drive energy and emissions savings. The proposed activity may be low cost or free in some cases. This activity is expected to be most attractive to businesses that have an existing network of hot pipes that needs its insulation replaced.

Consultation questions:

7. What are the most important factors in determining emissions savings from lagging hot pipework?

Implementation

Identification of approved lagging installation activities

There are two broad approaches to identifying whether an energy efficiency upgrade meets VEU deemed activity requirements, which are:

- developing a register of approved products, with any relevant installation of these products treated as meeting the activity specifications
- requiring the details of each upgrade be provided to the Essential Services Commission (ESC), who can make the decision at the activity creation stage on whether that specific installation meets the activity specifications.

The advantage of the approved register of products is that all parties have certainty about whether an installation meets activity requirements. The disadvantage is that product suppliers/accredited providers will need to register products, potentially becoming a barrier to the adoption of the activity. If pipe lagging installations are often bespoke combinations of different materials with different thicknesses determined according to the nature of the application, using a product register may not be practical. If pipe lagging installations typically use one of a small number of different combinations and thicknesses of materials a product register may be the simplest option.

If a register of products was not developed for hot pipe lagging activities, it would be important that the VEU program technical specifications for the proposed activity clearly define what the activity involves and communicate this in a manner which is meaningful to industry.

Consultation questions:

8. Would a lagging product register be more appropriate than submitting technical product details for each installation?

Skills and training requirements

It is expected there will be enough currently active professionals to support undertaking the proposed VEU hot pipe lagging activity.

Lagging manufacturers are likely to have the resources to access and apply the referenced standards to verify their products. Activity compliance will also require the installation standard (AS 4426) referenced in the activity to be understood by installers. As this is the standard referenced in the National Construction Code it is expected to be well understood in industry.

Consultation questions:

9. Are there any skills or training that may be required for the proposed activity?
    a. *Yes / No*
    b. If yes, please provide further information.

Submissions

Summary of consultation questions

1. Do you think our description of pipe lagging installation and replacement practices at **commercial facilities** (outlined above) is accurate?
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    b. If not, which other standards would you recommend and why?
5. What do you think is a reasonable warranty period (installation and product) that could be put in place to promote high quality lagging installations without creating a barrier to the activity?
6. Do you think there are other features that should be required as a minimum for the activity? (e.g. required cladding, or a maximum limit on thermal conductivity to ensure pipe diameter and hence heat loss area is not unnecessarily increased)
7. What are the most important factors in determining emissions savings from lagging hot pipework?
8. Would a lagging product register be more appropriate than submitting technical product details for each installation?
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Next steps

Key milestones in the introduction of the pipe lagging activity into the VEU program are:

• Open stakeholder consultation on the proposed activity	18 December 2020
• **Close stakeholder consultation on the proposed activity**	**5 February 2021**
• Response to stakeholder consultation on the proposed activity	March 2021
• Consultation on Regulations and Specifications for proposed activity	Second half 2021
• Finalise Regulations and Specifications	Second half 2021
• Pipe lagging activity introduced into the VEU program	Second half 2021