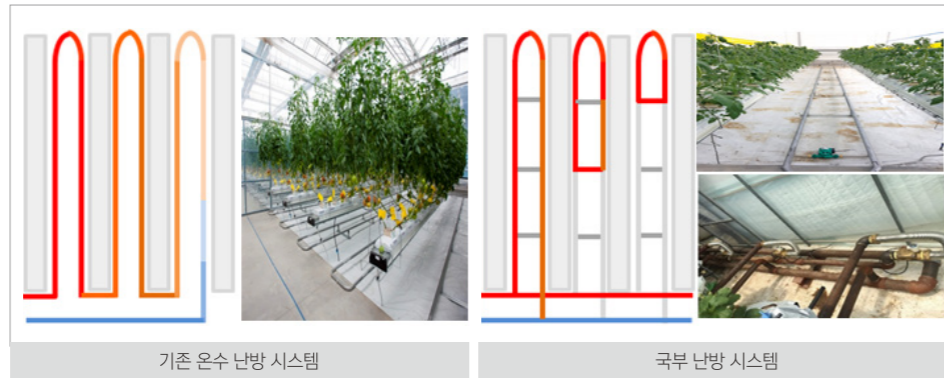


**연구책임자**  
에너지효율·소재연구본부  
에너지네트워크연구실  
**임용훈**

## 국부 난방 제어 기반 온실 스마트 열 환경 관리 기술

온실 및 스마트팜 온열 환경 제어에 있어, 작물 베드 위치별 열 환경 상황에 따라 위치별 방열량을 국부적으로 제어함으로써 온실 내 열 환경을 균일하게 유지, 에너지비용 절감(30% 이상) 및 작물 생산량(30% 이상)을 극대화 할 수 있는 온실 스마트 열 환경 정밀제어 기술.

### 기술의 구성도/개념도



### 기술의 주요 내용 및 특징

- 온수 공급 라인별 동일 조건 온수 공급이 가능한 온수 헤더 시스템
- 베드 온수 공급 라인별 부분 순환이 가능한 온수 배관 시스템
- 각 온수 공급 라인별 온수 방열량 제어가 가능한 비례제어방식 유량 제어시스템
- 각 베드별 열 환경 정밀 모니터링이 가능한 저가형 무선 열환경 센싱 시스템 및 정밀 제어 알고리즘

### 기술의 적용처

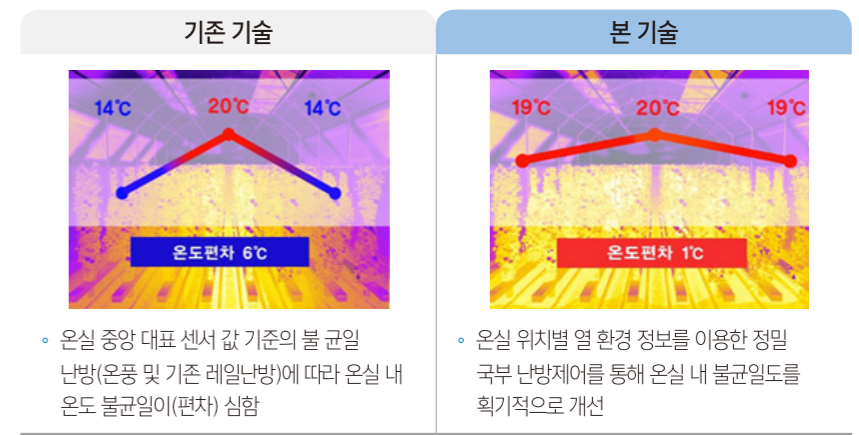
응용분야	적용제품
스마트팜, 시설원예, 온실 난방 공급 및 열 환경 제어 분야	온실 복합환경 제어 시스템, 스마트팜 최적에너지관리 시스템 등

**문의**  
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042-860-3384

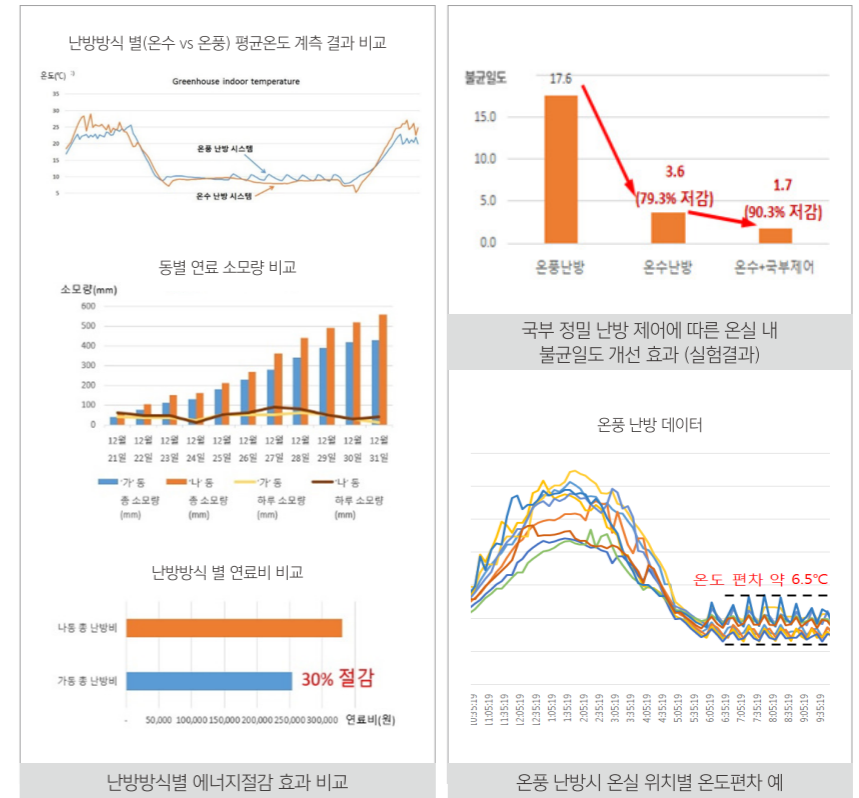
**E-mail**  
kier-tlo@kier.re.kr

### 기술의 비교우위성/ 기존 기술 대비 차별성



- 온실 중앙 대표 센서 값 기준의 불균일 난방(온풍 및 기존 레일난방)에 따라 온실 내 온도 불균일이(편차) 심함
- 온실 위치별 열 환경 정보를 이용한 정밀 국부 난방제어를 통해 온실 내 불균일도를 획기적으로 개선

### 실험 및 실증 데이터



### 기술의 성숙도



[TRL 6: 파일럿 규모 시작품 제작 및 성능 평가]  
Test Bed 구축 및 성능평가

순번	발명의 명칭	출원번호	출원일자	등록번호	등록일자
1	온실용 냉난방 시스템	10-2018-0047809	2018.04.25	-	-

### 지식재산권 현황

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**Im Yong-Hoon**

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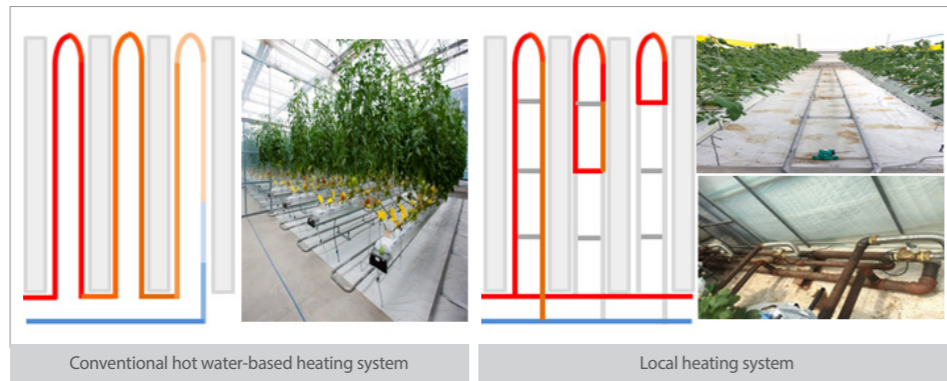
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## Local heating control-based greenhouse smart thermal environment management technology

The present technology is a greenhouse smart thermal environment precise control technology that may help to maintain a uniform thermal environment in a greenhouse, and reduces the energy cost (by over 30%), and increase the crop production (by over 30%) This is done by locally controlling the heat radiation at different positions depending on the thermal environment conditions of individual crop bed positions in the control of the thermal environment in greenhouses and smart farms.

**Structural Diagram/Conceptual Diagram**



**Description and Characteristics of Technology**

- Hot water heater system for providing hot water of identical conditions to individual hot water supply lines
- Hot water piping system allowing for partial circulation in individual lines for supplying hot water to beds
- Proportional control-based flow rate system allowing for the control of heat radiation from hot water in individual hot water supply lines
- Low-price wireless thermal environment sensing system and precise control algorithm allowing for accurate monitoring of thermal environment of individual beds

**Scope of Application**

Application Fields	Products
Smart farms, facility horticulture, greenhouse heating and thermal environment control	Greenhouse complex environment control system, smart farm optimal energy control system, etc.

**Comparative advantages of technology / Differentiation from existing technologies**

**Conventional Technology**

Temp. difference 6°C

- The conventional technology performs heating with reference to the values measured by the representative sensor located at the center of a greenhouse. As the heating may not be performed uniformly in the greenhouse (hot air and conventional rail heating), the temperature in the greenhouse is extremely heterogeneous (different).
- The precise local heating control using the thermal environment information from different positions in the greenhouse may significantly improve the heterogeneity of the temperature in the greenhouse.

**Present Technology**

Temp. difference 1°C

- The precise local heating control using the thermal environment information from different positions in the greenhouse may significantly improve the heterogeneity of the temperature in the greenhouse.

**Experimental and empirical data**

**Comparison of average temperature depending on heating method (hot water versus hot air)**

**Comparison of fuel consumption by the house**

**Comparison of fuel cost depending on heating method**

**Level of non-uniformity**

The local precise heating control technology has improved the heterogeneity of the temperature in the greenhouse (experimental results).

**Hot air heating data**

The effect of reducing energy consumption was compared between the heating methods.

Example of temperature difference between positions in the greenhouse under hot air heating.

**Maturity level of technology**



**[TRL 6: pilot-scale prototype preparation and performance evaluation]**  
**A test bed was established, and the performance was evaluated.**

No.	Title of Invention	Application Number	Application Date	Registration Number	Registration Date
1	Air conditioning and heating system	10-2018-0047809	2018.04.25	-	-

**Current status of intellectual property rights**