



HEATWAVE® SYSTEM

**CLEAN.
ECONOMICAL.
UNLOCKING HEAVY OIL.**

HEATWAVE® ADVANTAGES

Reduces greenhouse gas emissions through the use of less energy

Minimizes capital outlay and enables incremental expansion

Minimizes facility footprint by largely eliminating the need for water and reducing produced water

Integrates into standard oilfield drilling services and completions

Accesses resource-rich pay zones previously inaccessible through mining or steam-based processes

HeatWave® is an advanced, downhole heating system that leverages decades of Harris radio technology expertise. The system enables the ESEIEH® process, allowing for cleaner and more economical oil production from heavy oil and oil sands reservoirs.

ENABLING EFFICIENT EXTRACTION

Heavy oil and oil sands producers face a challenging business environment. Existing steam-based recovery processes are expensive, water dependent, energy and greenhouse gas-intensive. Their application is limited to formations tolerant to high pressures. HeatWave® enables a technique that allows producers to extract heavy oil and bitumen at a lower cost with a smaller environmental footprint and at lower operating pressures.

RADIO FREQUENCY HEATING

Just as microwaves heat food, HeatWave® heats the reservoir by transmitting radio waves. This eliminates the need for steam, associated water, and capital expense. Harris' radio frequency (RF) heating technology is based on decades of industry-leading RF development experience and is

designed to economically recover hydrocarbon resources while reducing the environmental impact when implemented as a part of our ESEIEH® process.

PRODUCING OIL THE "EASY" WAY

HeatWave® enables the patented Enhanced Solvent Extraction Incorporating Electromagnetic Heating (ESEIEH®) process. ESEIEH®, pronounced "easy," combines RF antenna technology and solvent injection to optimize the extraction process. This process offers dramatically lower energy requirements, greenhouse gas emissions, and capital requirements, with lower subsurface operating pressures.

The HeatWave® tool design has benefited from extensive laboratory and field testing, and the ESEIEH® extraction process is available for field trial in your heavy oil or oil sands reservoir.

HEATWAVE® COMPONENTS

ANTENNA LINER KIT

Provides the tools required to upgrade a standard well liner for electromagnetic heating capabilities

COMPLETIONS KIT

Provides the required tools to connect the surface facilities to the in situ well components

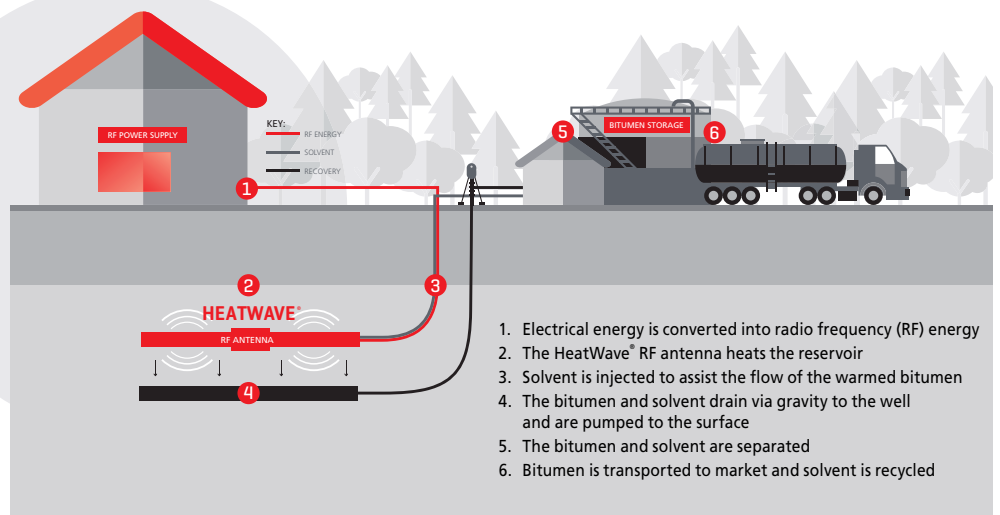
FACILITY KIT

Provides the electromagnetic heating surface equipment needed for sustained operations

PREHEAT KIT

Provides additional electromagnetic heating capacity during the high power phase at start-up

HOW THE HARRIS HEATWAVE® ENABLED ESEIEH® PROCESS WORKS:



HeatWave® is putting decades of radio technology expertise and innovation to work below the surface, generating heat within the reservoir for thermally enhanced oil recovery and eliminating the need for water in the process.

THE POWER SOURCE AND TRANSMISSION

The HeatWave® system consists of an RF power source, a coupling unit, and a transmission line to energize the downhole antenna. The RF power source has a long operational life and can be utilized across many RF heating projects. The transmission line is optimized for efficient transmission, even across long distances in rugged environments.

THE ANTENNA

The HeatWave® system is configurable to a variety of reservoir conditions and production scenarios, and can be tuned to match the impedance of the pay zone within an RF frequency range. The system requires no permanent above-ground infrastructure and integrates easily into standard oil field drilling and completion processes with minimal impact to rig operations.

WHY HEATWAVE®

The HeatWave® tool design benefits from decades of Harris radio technology expertise and extensive laboratory and field testing. With a modular design, easy integration, and essentially no need for water, HeatWave® is the key to improving the economics of oil recovery and accessing previously uneconomic or inaccessible resource-rich pay zones.

About Harris Corporation

Harris Corporation is a leading technology innovator, solving customers' toughest mission-critical challenges by providing solutions that connect, inform and protect. Harris supports government and commercial customers around the world.

Learn more at harris.com.

To begin an ESEIEH® extraction process field trial in your heavy oil or oil sands reservoir, contact us at:

RFHeating@harris.com

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HARRIS® TECHNOLOGY TO CONNECT,
INFORM AND PROTECT™