

## Advanced Transient Multiphase Flow Simulator

LedaFlow is a software solution designed to optimize continuous flow assurance for oil, gas, CO<sub>2</sub>, hydrogen, and steam, prioritizing safety, economic efficiency, and environmental sustainability.

LedaFlow's physics-based approach solves the fundamental conservation equations (mass, energy, and momentum) for each phase (oil, gas, and water), providing high-resolution multiphase flow simulations. This accuracy is crucial for simulating critical transient events, leading to a deeper understanding of fluid dynamics and improved scalability for complex systems.

The dynamic multiphase flow simulator is the result of years of innovation by SINTEF, with sponsorship and guidance from TotalEnergies and ConocoPhillips, and commercialization and further development by Kongsberg Digital.

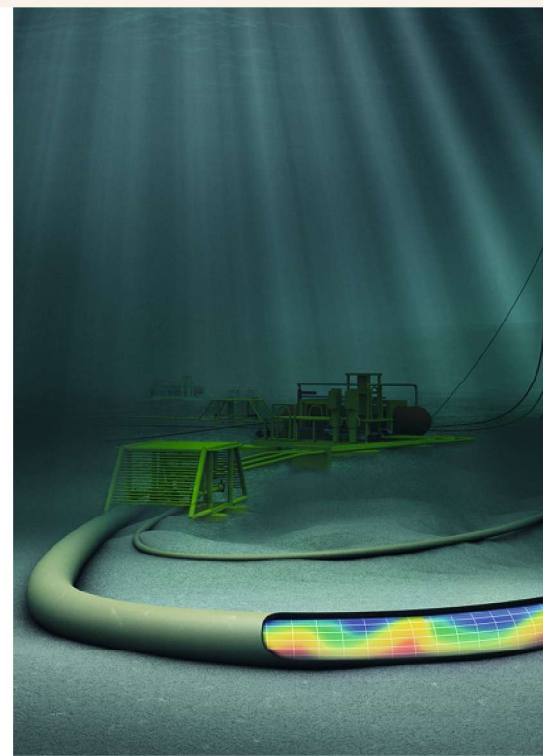
### Process equipment performance monitoring

LedaFlow provides detailed multiphase flow modeling by calculating mass balance for nine distinct fields—gas, oil, and water, each with bulk and two dispersed components. Momentum and energy are then calculated for the continuous gas, oil, and water phases. This detailed approach enables accurate comparison with laboratory and field data.

### Advanced thermal modelling

LedaFlow solves individual energy equations for each of the three phases, enabling more accurate temperature predictions, particularly during stratified flow and blowdown conditions when significant temperature differences can exist between the liquid and gas phases. In addition, a buried pipe model provides a heat conduction model from the pipe's inner surface to the surrounding soil.

The ability to accurately estimate corrosion rates and pipe-wall temperatures is critical for ensuring pipeline integrity through proper material selection and effective hydrate risk management.



### HIGHLIGHTS

- Advances accuracy and usability in multiphase flow simulation
- Widely used by operators and their service companies
- Routinely employed for flow assurance and production engineering
- Directly integrates with K-Spice for enhanced process simulation
- Used across multiple dynamic simulation and production platforms
- CO<sub>2</sub>LINK integrating flow and reservoir simulators for CO<sub>2</sub> injection
- Cloud-native access with Kognitwin® Simulation
- All-inclusive software, proven since 2011

## Slug flow modelling

LedaFlow employs a Unit Cell Model to simulate terrain and riser induced slugging. It also includes LedaFlow Slug Capturing® which is the first commercially available solution to accurately predict hydrodynamic slug behaviour without requiring user input. It employs higher-order numerical methods to resolve the complex dynamics of wave and hydrodynamic slug formation and evolution. Dedicated tools provide detailed slug statistics and size distributions for comprehensive analysis.

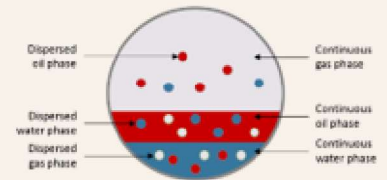
## Model validation

LedaFlow is thoroughly validated against the best available and most comprehensive experimental data sets to ensure that the models are as representative as possible. It undergoes rigorous validation against the most extensive and high-quality experimental datasets available, ensuring accurate representation of real-world behaviour.

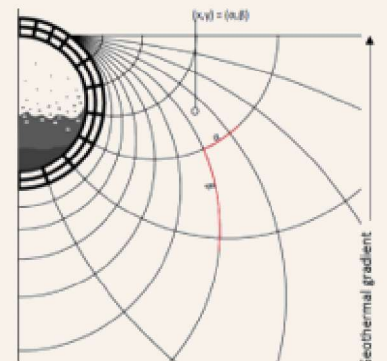
The ongoing LedaFlow® Improvements to Flow Technology (LIFT) program (established in 2013) ensures continuous improvement and verification. Members of LIFT have included Chevron, ConocoPhillips, ENI, Equinor, ExxonMobil, Lundin, Shell, Total Energies and Woodside.

## Latest software technology

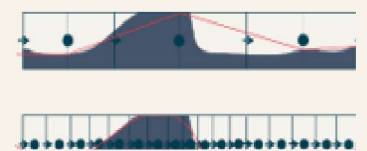
LedaFlow offers a comprehensive modelling solution, including an intuitive user interface for enhanced productivity, 3D visualization for improved understanding of multiphase flow, a robust relational database for efficient case management, and flexible scripting capabilities for programmatic control and automation.



Multi-field approach



Advanced thermal modelling



Slug flow modelling

## LEDAFLOW BENEFITS INCLUDE:

Composition tracking	Leveraging Multiflash™ for compositional modelling of phase slip, mass transfer, and mixing.
Wells	Model wells with IPRs and custom inflow zones, including fracture and viscosity features; and simulate transient gas lift via annulus flow and valve tables.
Custom fluids	Track hydrate inhibitors (MEG, MeOH, EtOH) or single components (e.g., muds, tracers, oil) concentrations across all phases.
Wax deposition	Optimize pigging frequency by modelling wax deposition with pressure and temperature influence.
Hydrate transport	Simulate hydrate particle formation and transport to assess hydrate risk regions, considering inhibitor, heat of reaction, and fluid property effects.
Pure steam/water	Accurate water hammer studies through integrated steam thermodynamics and flexible wall modelling.
CO <sub>2</sub> injection	Streamline CO <sub>2</sub> injection and storage processes and enabling seamless modelling of the interaction between well and reservoir systems through coupling to reservoir simulations with CO <sub>2</sub> LINK.



LedaFlow Technologies DA, founded in 2013 by ConocoPhillips, TotalEnergies, SINTEF, and Kongsberg Digital, develops and delivers industry-leading multiphase flow simulation tools, leveraging the combined expertise of its partners.