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June 01-03, 2017 Osaka, Japan

# Posters

Szymon Kuczynski et al., J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Economic analysis of energy storage in the form of hydrogen in salt caverns

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With currently observed increase of the demand of hydrogen, new ventures and projects are conducted to deal with certain stages of generation of this chemical element. Hydrogen has numerous advantages in various industries. The most crucial one is the wide range of production techniques using several resources, making it more applicable as compared to other chemical elements. The other advantage is its environmental friendly application as an energy source. This issue may make considerable change in automotive industry in the nearest future. With certain number of advantages, a few disadvantages are observed. The most essential problem is associated with lack of necessary facilities: Mass production units, transportation grids and storage systems. The last point could be solved with salt caverns and depleted oil and gas reservoirs, as they offer large deposit quantities and impermeable interior to keep the hydrogen inside. Complex examination of this part would simplify and intensify the technical studies regarding the hydrogen usage. Paper investigates the economic influence of particular parameters of hydrogen storage in salt caverns. The initial point of the research is the stage of leaching the cavern to enable the storage with any relevant machinery. The following cavern elements involve completion devices as wellhead and exploitation pipes. Surface technical setup consists of the hydrogen compressing facility, pumping equipment, gas (hydrogen) drying unit, gas reduction and measurement plants. Necessary supporting infrastructures needed to maintain the work: Electric steerable systems, preparation of plant (ground possession, construction of roads and staff base). The economic analysis covers different scenarios with respect to the localization, cavern volume, years of usage of the facility and resources prices. NPV and IRR factors for scenarios are evaluated.

## Biography

Szymon Kuczynski is currently working as a Research Assistant in Natural Gas Engineering Department. His research interests are related to fluid mechanics, natural gas composition analysis, real time *in situ* monitoring systems, energy sources and mathematical models.

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**Notes:**

Mariusz Laciak et al., J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Innovative solution dedicated to performance and safety tests procedures of compressed natural gas (CNG) home fast refueling stations

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Mobility is a must of everyday life, which led us to the oil dependence. Global economic changes caused that natural gas is recognized worldwide as the main and leading alternative to oil products in the transportation sector. There is a huge barrier to convince vehicle users to switch to natural gas, the lack of refueling infrastructure for natural gas vehicles (NGV) is frequently the case. The key to solve this problem is to provide a refueling infrastructure solution for natural gas vehicles, fast refueling units ready to work in household condition. Home fast refueling units operate with natural gas (methane), which is being provided through gas pipeline grid and become the largest vehicle refueling infrastructure. Home fast refueling units and NGV owners will enjoy day-to-day time savings and convenience: Home car refueling in minutes, month-to-month fuel cost economy, year-to-year incentives and tax deductibles on natural gas refueling system as per country, reduce $CO_2$ local emissions, saving costs and money. The procedures of the final production prototype, independent of operational performance and accounting for the safety issues have been tested and described in the paper. The aim of the safety tests is to test externally and independently analyze HRS production prototypes for safety aspects. The test simulated various scenarios and operational conditions and situations and was analyzed to show how current production prototype responds to various simulations. The operational performance tests were dedicated to external independent testing of HRS production prototypes for operational performance. The main tested parameters were productivity $m^3/h$, energy consumption kW/h, the speed (rate) of refueling is hour or min.

## Biography

Mariusz Laciak is a Professor and Head of Natural Gas department at Drilling, Oil and Gas Faculty at AGH UST. His main research activities are related to natural gas transmission, natural gas production, natural gas energy and utilization.

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**Notes:**

Tomasz Wlodek et al., J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Possibilities and selected aspects of hydrogen energy storage

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Energy storage methods may be used for covering energy demand fluctuations and for integration power generation from renewable energy sources as wind plants and solar farms. Classic form of energy storage is hydropower energy storage in top-pumped power plants. Other possibilities of energy storage as alternatives for classic solutions are compressed air or hydrogen energy storage in appropriate geological conditions. Salt caverns are the most relevant formations for hydrogen and compressed air energy storage. The possibilities of hydrogen energy storage application in Polish conditions are presented in this paper. In Poland, there are many suitable geological formations for salt caverns construction, especially in northern and north-western part of the country. Also in northern and western part of Poland, there are the most suitable wind conditions for wind farm localization. The location of large industrial plants (e.g., oil refineries in Gdansk and Plock), which need hydrogen for their technological processes, is also very important factor. In this case the salt caverns may be hydrogen storage for industrial purposes besides the energy storage. This situation requires the design of all infrastructures for transportation and utilization of hydrogen. Hydrogen may be transported in especially designed high pressure pipelines. Pipeline transport of hydrogen is quite similar to natural gas transport. Physical properties of hydrogen cause lower pressure drops along the pipeline. One of methods of hydrogen utilization is to add it to natural gas pipeline system for improvement of natural gas transportation parameters. Hydrogen transportation and storage processes causes' material challenges because of the hydrogen potential to penetrate the crystal lattice of steel leading to hydrogen corrosion. In this paper underground hydrogen storage methods and design aspects of salt caverns and infrastructure challenges are considered. It is concluded that there are possibilities for effective hydrogen energy storage in Poland.

## Biography

Tomasz Wlodek is currently working as a Research Assistant in Natural Gas Engineering Department. His main research interests are related to LNG technology, pipeline transmission of natural gas, hydrogen and CO2 and natural gas composition analysis.

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**Notes:**

Qunming Liu et al., J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Optimized well spacing technique of mixed well type for tight gas sand in China

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With continuously deeper development of "Sulige" Gas Field, which is domestic typical representative of Tight Gas Sand, its development pattern has already changed from single vertical well development to multiple well-type development including vertical, cluster and horizontal well. How to optimize Well Spacing of multiple well type under complicated geological conditions is one of key technique problems for enhancing recovery rate of gas field. Based on the fine geological a anatomy of dense well pattern test area using reservoir architectural analysis method, large-scale composite sand body of braided river is divided into 4-grade architectural elements, which is braided river system, composite channel sand body, single channel and point bar and optimizing well spacing technique targeting composite channel sand body, the second grade architectural elements, has formed. According to the differences of interior reservoir structure characteristic, three lithofacies types of the second grade architectural elements, which is superposition belt, transitional belt and inter-system belt is identified, and ancient landform controls the distribution of different lithofacies types. Reservoir pattern determine development well type: superposition belt suitable for the integral development of horizontal well, transitional belt suitable for the cluster well development, and inter-system belt suitable for the vertical well development of sweet spot, and quantitative recognition standard of various lithofacies has been established. The field application of such technique showed satisfactory results, 63 horizontal wells, 9 cluster well groups consisting of 5~7 wells, and 12 vertical wells, have been deployed, and numerical simulation result shows recovery rate of gas field is enhanced a lot due to mixed well type development especially horizontal well development. Research results instructed the next development of Sulige Gas Field, and provide reference for domestic gas reservoir of such type.

## Biography

Qunming Liu is currently a Reservoir Engineer in Research Institute of Petroleum Exploration Development, CNPC. He received Master's degree in Petroleum Geology from China University of Geosciences (2009) and PhD in Petroleum Development Engineering from the Research Institute of Petroleum Exploration Development (2012). His main research interests are natural gas development geology and tight gas development.

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**Notes:**

Cheng Lihua, J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# The characteristics and development patterns of basement reservoir: A case study of Dongping gasfield, in the Qaidam basin

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So far, oil reservoirs account for most of the basement reservoirs which are developed. Basement gas reservoirs are relatively rare and most of them are developed for a short period. The Dongping gasfield of the Qaidam basin is a typical basement reservoir, which were developed in 2013. It is very meaningful to study on the development characteristics of basement gas reservoirs in depth. The thick basement rocks are usually old blocks which have endured a very long period of uplifting, exposure and weathering. There are mainly two types of reservoir spaces in basement rocks. One of them is the zone of dissolved pores and caves, which is commonly a thin zone with relatively good porosity. The other is the fracture belt, which is a relatively thick and less porous belt formed by the mechanism of tectonic movement, surface water dissolution or/and underground water dissolution. These two types of reservoir spaces make the basement rocks a typical dual-porosity reservoir. Basement reservoirs are always characterized with low porosity and relatively high permeability. The tested productivities of basement reservoirs are very high. Some wells may show open-flow capacities more than a million m3/d. The high tested productivities may be caused by high connectivity of basement reservoirs, which makes it much easier for gas to flow in a large area. Another characteristic of basement reservoir is their high single well production rate and their capacities for stable production. Their production indexes are in the range of maximum production capacity. This is depended on the controlling of producing rate and the preventing of bottom water coning. Comparing to conventional gas reservoirs, basement reservoirs show some unique features, which are their block shape, high reservoir connectivity, bottom water and high single well producing rate. Development of basement reservoirs should pay full attention to those unique characteristics. Development strategy should be based on the view of the whole reservoir and well pattern should be optimized to yield a high production rate.

## Biography

Cheng Lihua is a Senior Gas Development Engineer. He has received his PhD in Petroleum Geology from China University of Petroleum in 2006. He has worked in Research Institute of Petroleum Exploration and Development. For the past 10 years, he has been engaged in the research of reservoir characterization, tight gas development, carbonate gas development, and basement rock gas development. He has published more than ten articles and one book about oil and gas development.

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**Notes:**

Gao Xiaolong et al., J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Bioemulsifier mediated high concentrations of sludge treatment technology and application

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The bioemulsifier was secreted by strain *Geobacillus pallidus* XS2-450 which was obtained based on atmospheric and room temperature plasma (ARTP) mutation of XS2, isolated from oil-contaminated soil in the Yumen oilfield, China. The bioemulsifier was extracted, purified and characterized, and its emulsifying properties were evaluated. The purified bioemulsifier showed high emulsifying activity (E24%=83%) on xylene. The chemical characterization of the bioemulsifer was performed using HPLC/MS/MS and GC/MS. It was found to contain 76.2% of carbohydrates, consisting mainly of galactose mannose rhamnose and glucose, 7.3% proteins with a 60 KDa active component and 16.5% of lipids. The results suggest that the bioemulsifier was a glycolipids-protein complex. Furthermore, the composite microbial communities major including bioemulsifer, biosurfactants and other active metabolites coupled with nutrients and trace elements were used to deal with sludge samples, the oil content of the oily sludge samples decreased from 6.1% to 0.8%. These data illustrated that the bioemulsifier performed a high potential in applications and had important economic values.

## Biography

Gao Xiaolong is a Master's student whose research focuses on the purification and structure analysis of bioemulsifier, and environmental remediation of petroleum hydrocarbon pollution, especially towards the heavy crude oil polluted soil and water.

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# Petroleum and Refinery

June 01-03, 2017 Osaka, Japan

## e-Posters

Sergey K Sokhoshko, J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Modeling the operation of complex trajectory oil and gas wells in the steady state

**Sergey K Sokhoshko**
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**Statement of the Problem:** Presently when drilling horizontal wells the length of a wellbore traced through the producing formation can stretch many hundreds of meters. In order to calculate productivity of such well and its separate intervals it is very important to know the fluid to the wellbore inflow profile, inflow rate along the wellbore as well as pressure drop along the wellbore. The objective of this study is to obtain a technical solution and to develop a calculation technique which would allow calculation of the above operation parameters for steady state of both oil and gas wells with complex trajectories.

**Methodology & Theoretical Orientation:** The point source method was used to simulate perforations in the wellbores of both oil and gas wells in order to calculate the mode of operation of a complex trajectory well. A calculation result for a fixed flow point source in a formation with impermeable top and bottom and available external reservoir boundary (injection wells) was obtained using results of calculations of the fixed flow point sources in an infinite formation in addition to the infinite imaging method relative to the top and bottom of formation.

**Findings:** Productivity of a complex trajectory well as well as the profile of fluid movement to the wellbore depend on the well trajectory, type of bottom hole completion and producing formation parameters, which have to be taken into account both in well planning as well as in field development design stages.

**Conclusion & Significance:** The designed technique allows to calculate the productivity in complex trajectory wells and in its separate intervals, pressure drop in the wellbore, increases in the oil and gas flow rates, as well as to calculate an optimum length of horizontal section of the wellbore and its trajectory through the producing formation.

## Biography

Sergey K Sokhoshko has defended his PhD thesis at the Tyumen State Oil and Gas University (Russian Federation). Currently, he is a Professor of the Department of Oil and Gas Fields Development and Production. He specializes in modeling of oil and gas wells with complex trajectories, as well as hydraulic fracturing.

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**Notes:**

Muhammed A Ismail et al., J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# 3D permeability distribution modeling from porosity wire line logs and irreducible water saturation graph - A case study on small giant Bai Hassan oil field, Northern Iraq

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The main aim of this research is to determine nearest and acceptable predicted permeability value obtained from wire line logs compared with those values coming from core sample analysis within two wells belonging to two domes from small giant Bai Hassan oil field, using irreducible water saturation graph method. This work consists of three main parts: Part one is well logs analysis, which involves determination of Archie petrophysical parameters, porosity corrected from volume of shale, water saturation and irreducible water saturation. The second part is predicting permeability using irreducible water saturation from well log analysis and comparing the estimated values with the data of permeability that measured from core sample in BH-20 and BH-53 well. The last part was using SPSS statistic software to determine the factor that can give the very nearest and acceptable values, these values uses to estimate real permeability for another wells distributed on each dome of the small giant Bai Hassan oil field. Excellent correlation obtained ($R^2$=0.978 in BH-20 and $R^2$=0.9945 in BH-53) between estimated permeability values based on irreducible water saturation and permeability that got from core sample. The result of statistical method (SPSS software) is:

$K_{Core} = (K_{Predicted} * 1.040) - 3.363$ (BH-20) [Kithka Dome]

$K_{Core} = (K_{Predicted} * 1.030) - 3.359$ (BH-53) [Daoud Dome]

## Biography

Muhammed A Ismail graduated from Baghdad University, Faculty of Engineering, Petroleum Engineering Department in 2006, June. In September 2007, he successfully passed the Turkish examination conducted in Kirkuk and got eligibility to study Master's in Republic of Turkey. In 2007, he started in Gazi University in Turkey, Ankara, Training and Education Center (Tomer). I participated successfully TCS exam in 2008, July and got study in Istanbul University. In 14-Oct-2008 registered in Istanbul University Faculty of Engineering Geological Engineering Department. In 18-Aug-2011 graduated from this school and got a master's degree. In 2011, September I started working as a teaching in Kirkuk University. In 2013, October I got a scholarship to study for a doctorate PhD in Azerbaijan, Baku. Know I'm studying in Khazar University Faculty of Engineering and Applied Science, Petroleum and Gas Engineering department.

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# Petroleum and Refinery

June 01-03, 2017 Osaka, Japan

# Accepted Abstracts

J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Freeze for balance: Oil outlook 2017

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Oil markets have experienced a tumultuous last 24 months. Oil price volatility has been exacerbated by the financial markets and unprecedented outages in the first half of 2016. At a fundamental level, markets had started to rebalance very rapidly earlier this year on the back of stronger growth in global demand and unprecedented supply outages, leading to even small withdrawals. However since the start of third quarter, the pace of physical market rebalancing has slowed due to changes in the supply-demand dynamics. Additionally in the last 12 months, oil prices have been driven significantly by non-fundamentals factors such as speculative positions and US dollar moves. We believe physical balances in the near term will remain sensitive to oil price recovery and vice versa. The time required for full and sustainable rebalancing of the markets will depend significantly on how various factors including OPEC strategy, CAPEX cuts, demand for oil products and global growth pan out in the near term. Without an OPEC freeze, the rebalancing of the markets in the near term will depend on supply outages not returning and growth in demand (for consumption and strategic reserves) remaining strong.

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J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Automated hyperspectral imaging from afar: Identifying gas leaks early and at the source

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Explosions due to hydrocarbon gas leaks at refineries and offshore sites have claimed hundreds of lives and cost billions of dollars in repair and retribution. Early detection of gas leaks can help to avoid such events, thereby protecting workers and preventing destruction of equipment. Currently, the standard technology for hydrocarbon leak detection is a mesh network of point monitoring sensors. While point sensors are sensitive and can provide a reading of the concentration at a single point, they do not provide a picture of the leak source and plume direction. Furthermore, they require the gas plume to reach the sensor which is often long after the leak has started. Because of these issues, infrared cameras have started to gain popularity as they allow a user to see a gas cloud. However, these cameras pose some issues to gas cloud detection. For instance, they require an operator to view all video and interpret the results. This introduces operator error into the equation, especially since it is hard to distinguish between gas and steam in the infrared spectrum, increasing the chances of incorrectly categorizing the results. Rebellion Photonics' Gas Cloud Imaging is a hyperspectral system that is completely autonomous, allowing 24/7 monitoring with no need for an operator to watch the feed. GCI technology detects gas leaks at the source, providing an earlier, more reliable alarm. With the ability to identify 25 different hydrocarbons, including methane, GCI technology employs advanced algorithms to determine gas type, leak rate, leak location and total volume of the leak automatically, without the need for user interpretation. The snapshot GCI relays real-time visible range video simultaneously with co-located infrared video, providing spatial and temporal information about the plume while quantifying the gas leak using long-wave infrared spectroscopy. In this study, the novel technique of snapshot hyperspectral GCI was applied to detect and quantify gas leaks in real time with high specificity. The detection range of the snapshot GCI camera was tested at 1500 m with ambient temperature of 23 °C and wind gusts of 10 MPH (16 km/h). The snapshot GCI camera detected a gas release with a cross section of approximately 1 m2 and accurately identified the gas as propylene. The snapshot GCI camera has been optimized for outdoor operation and has explosion-proof housing for operation in hazardous environments. The camera operates reliably at temperatures of -40 °C to 55 °C and in adverse weather events such as rain, snow and sandstorms. This technology can catch leaks early, help prevent employees from walking into a hazardous cloud and allows the operator to make process safety decisions to avoid leak escalation that can lead to 'low-frequency, high-consequence' events such as fires and explosions.

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J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Investigation of well plan parameters for directional drilling in Gulf of Thailand

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Directional drilling is commonly practical in complex structure reservoir as Gulf of Thailand. Directional well path is planning by difference well planner experiences. After, torque and drag analysis will be performed to examine drillability of well path. If torque and drag exceed limit, well plan will be adjusted in order to reduce torque and drag. Although the method is still considered effective; but the selected well design may not be the best one technically or economically. As mention, well plan is depend on well planer experience. This process may take time and effort. This study will provide optimum sets of well plan parameters i.e. kick of point (KOP), inclination (INC), build rate (BUR) based on torque and drag as criterion, to improve well planning process. The optimum parameters set and limited of well plan parameters for each well profile can be used as a guideline for all well planer experience level. The scope of this study is based on 4 well profiles; 2 dimensional (2D) build and hold, 2 dimensional (2D) build hold and drop, 3 dimensional (3D) build and hold and 3 dimensional (3D) build hold and drop. Well plan parameters are varying, while formation properties, operation conditions, drilling parameters and drillsting components are constrained. Derivative torque and drag from each well profile will be observed and analyzed. For 2D build and hold profile, the preliminary result show that maximum torque straight declines with deeper kick of point. The declined is enlarged while deviated inclination is lager. Build rate affected smaller compared to other 2 varying parameters. The limited of well design can be determined from straight line equation.

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J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Cationic and hydrophobic chitosan nanoparticles as emulsion stabilizing agents for underbalanced drilling fluids

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The discovery of the pre-salt in Brazil led to drilling operations through reservoirs located above the pre-salt that have produced oil and gas for decades, being, therefore, depleted zones presenting very low pore pressure. For drilling through a depleted zone, underbalanced drilling (UBD) is used to avoid rock fracture, loss of circulation and imprisonment of the column. Researchers have reported the use of various methods in UBD, such as the addition of hollow glass spheres, foams, Aphrons and emulsions. Direct emulsions are interesting because they are environmental friendly, since they form a water-based fluid, present low cost and higher penetration rates. Emulsions-Pickering is a stabilization mechanism through the use of particles that can lead to very stable systems. The purpose of this study is to use chitosan derivatives nanoparticles as emulsion-Pickering stabilizers for the formulation of low density aqueous base drilling fluids. The nanoparticles of chitosan derivatives were prepared by the ionic gelatinization technique and were characterized by FTIR, interfacial tension, TGA and scanning electron microscopy. The nanoparticles were added to the aqueous phase and an olefin was used as the oil phase for the oil-in-water (o/w) emulsion, which was the base for the low density drilling fluid. The stability of the emulsions was assessed by visual aspect, DLS, optical microscopy and DSC. The complete drilling fluid formulation had its performance evaluated by API tests. The chitosan derivatives nanoparticles have shown to be able to produce high stability o/w emulsions and the cationic derivative (TMQ) nanoparticles were more efficient than the nanoparticles from the cationic and hydrophobic derivative (TMQ-C14). It is believed that their particle shape and size are responsible for this difference in efficiency. The density and the API parameters for the formulated drilling fluids did meet the needs for a UBD.

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J Pet Environ Biotechnol 2017, 8:3 (Suppl)
DOI: 10.4172/2157-7463-C1-029



# Petroleum consumption and economic growth relationship: Evidence from the Indian states

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This paper reveals that over the period 1985 to 2013, the richer states of India saw a prevalence of the feedback hypothesis between real GDP growth and petroleum consumption in the long-run and the short-run. Over the short-term, the (major) 23 Indian states panels show support for the conservative hypothesis. For the panels comprising low and middle income Indian states, while we are able to show significant bidirectional effects, none of the results resonate with the standard definition of the feedback hypothesis that energy consumption increases economic growth which in turn encourages growth in energy demand. Instead, we discover that for the middle and low income states, past higher petroleum consumption can in fact deteriorate economic activity in the short- and long-run. Additionally, for the low income states of India, higher economic growth predicts a fall in petroleum demand.

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