

## Cutting into Ohio's Bedrock State slashes funding for Geological Survey

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### Introduction

Ohio's Division of Geological Survey, part of the Ohio Department of Natural Resources (ODNR), is responsible for collecting, maintaining, and disseminating information related to the state's geology. Although the agency's activities are critical to public safety and a wide range of private and public sector economic activity, the state legislature voted to eliminate all of its General Revenue Fund (GRF) allocations between fiscal years 2010 and 2012.<sup>1</sup> The Geological Survey carries on, thanks to federal grants and their matching state funds (for Geologic Mapping), and minor fees. But its capacities are significantly diminished, and it is unable to continue many of the important activities it once carried out. As hydraulic fracturing, or fracking, brings new attention to Ohio's geology and heightens the significance of ODNR's work, the evisceration of funding for the Ohio Geologic Survey may impact Ohioans in unexpected ways.

### History of the Geological Survey

The Ohio Geological Survey (OGS) was created by the state legislature in 1837, and is organized as part of ODNR.<sup>2</sup>

Although OGS collaborates and, until recently, received much of its funding from the United States Geological Survey, its inception actually predates its federal counterpart by 42 years.<sup>3</sup> In addition to mapping the state's underground geology, OGS's early work also involved zoology, botany, archeology and paleontology.<sup>4</sup> This early work was critical to the growth of Ohio's coal and salt mining industries, among others. Although the Survey's continuation was threatened by the onset of the Great Depression in 1929, OGS supporters successfully lobbied to retain partial funding and maintain a skeletal staff until the end of the depression. The legislature restored full funding in the early 1940s. By the first decade of the 21<sup>st</sup> century, the Survey's role included a wide range of ongoing functions, detailed below. The agency currently lists 23 staffers on its website.

### Funding

Historically, three line items have comprised the OGS budget. General Revenue Funding for "Division of Geological Survey" provided general operational support to fund most of the agency's

### Key findings

- From 2003 to 2012, state funding for OGS dropped by 74 percent.
- OGS monitors seismic activity, of increasing importance as hydraulic fracturing increases in Ohio.
- Consultant study commissioned by OGS estimates its services saved government and industry hundreds of millions in 2010.
- The public relies on OGS to monitor beaches and shorelines, provide data used in building roads and bridges, and protect against an array of geological hazards.

<sup>1</sup> FY 2012-13 Final appropriations, Ohio Legislative Service Committee; at [www.lsc.state.oh.us/fiscal/bid129/](http://www.lsc.state.oh.us/fiscal/bid129/).

<sup>2</sup> For historical information on OGS, see <http://www.dnr.state.oh.us/tabid/7811/Default.aspx>.

<sup>3</sup> Rabbitt, Mary C. "The United State Geological Survey: 1879 – 1989," available at <http://on.doi.gov/byJYCw>.

<sup>4</sup> "Historical Timeline of the Ohio Geological Survey, 1837 – 2012," available at <http://bit.ly/KMqIRE>.

primary functions, including the H.R. Collins Laboratory, some types of mapping, work in collaboration with mining and drilling companies, and various research projects. State Special Revenue funds, the second major component of the OGS budget, support “Ohio Geologic Mapping” operations. This line item is funded by Ohio’s “Geological Mapping Fund,” which is in turn funded by state severance taxes.<sup>5</sup> This funding supports research and administrative tasks necessary for creating various geological maps used by private industry and government. OGS also receives federal matching funds from the United States Geographical Survey (USGS) to support the same mapping activities; these funds constitute the third major source of the agency’s funding. USGS provides \$0.80 for each SSR dollar that funds “Ohio Geologic Mapping,” although OGS has received additional federal funds for other projects in some years.

In 2003, GRF funding for the Division of Geological Survey comprised 59 percent of the agency’s funding, while SSR funding for Ohio Geologic Mapping comprised 22 percent and federal matching funds comprised 19 percent.

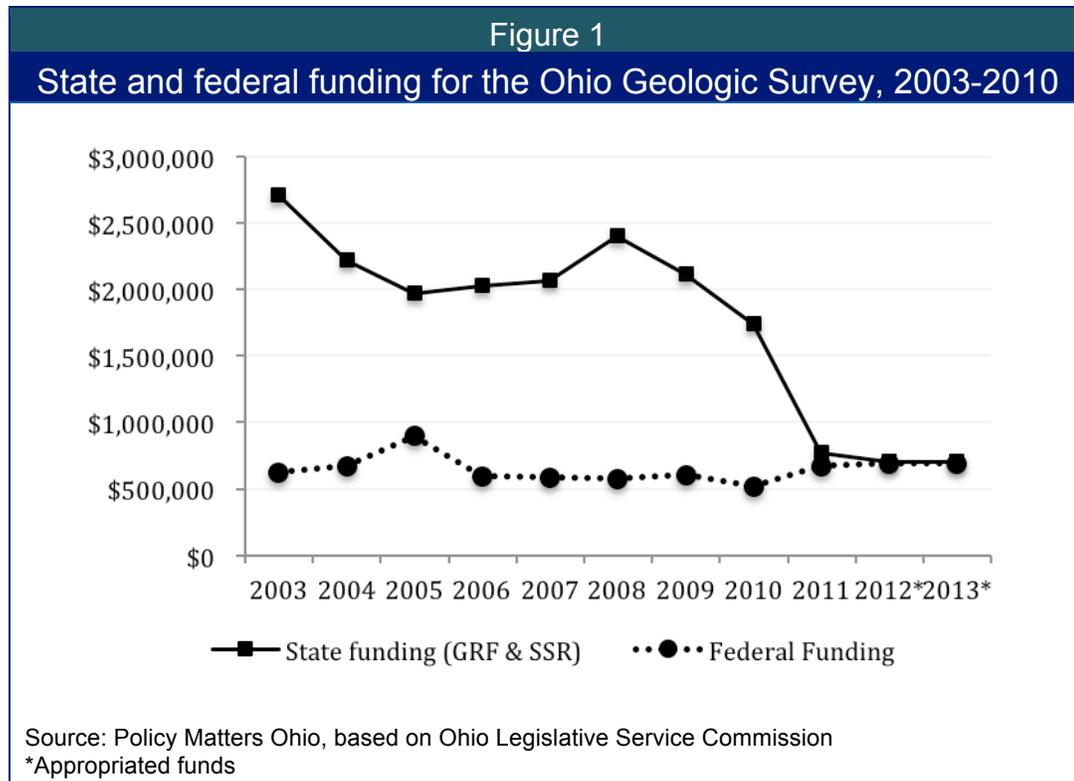
The Ohio Geological Survey lost 100 percent of its appropriations from the state General Revenue Fund between 2010 and 2012. This was not the beginning of budget cuts for OGS; the agency’s overall funding had been in decline since 2003. From 2003 to 2010, GRF allocations for the Division of Geological Survey shrank by 46 percent, from \$1.97 million to \$1.05 million. Allocations then shrank to a negligible \$3,180 in 2011, and the Division of Geological Survey line item was eliminated in 2012.

<b>Year</b>	<b>Division of Geological Survey (728321)</b>	<b>Ohio Geologic Mapping (725646)</b>	<b>Geological Survey Federal (725632)</b>	<b>Total</b>
<b>2003</b>	\$1,969,117	\$748,248	\$616,912	\$3,334,277
<b>2004</b>	\$1,708,870	\$512,866	\$671,066	\$2,892,802
<b>2005</b>	\$1,552,209	\$417,215	\$895,125	\$2,864,549
<b>2006</b>	\$1,729,222	\$303,469	\$593,290	\$2,625,981
<b>2007</b>	\$1,536,033	\$534,926	\$586,687	\$2,657,646
<b>2008</b>	\$1,672,909	\$728,667	\$571,453	\$2,973,029
<b>2009</b>	\$1,390,344	\$725,124	\$601,923	\$2,717,391
<b>2010</b>	\$1,054,911	\$686,514	\$520,221	\$2,261,646
<b>2011</b>	\$3,180	\$767,174	\$666,889	\$1,437,243
<b>2012*</b>	\$0	\$704,777	\$692,401	\$1,397,178
<b>2013*</b>	\$0	\$705,130	\$692,401	\$1,397,531

Source: Policy Matters Ohio, based on Ohio Legislative Service Commission, Budget in Detail (\* Appropriated)

<sup>5</sup> Severance tax support of OGS includes: 100% of salt severance tax revenues; 4.76% of coal severance tax revenues; 7.5% of limestone, dolomite, sand, and gravel severance tax revenues; and 10% of oil and natural gas severance tax revenues. From Hoffmeister, Brian, “Analysis of the Enacted Budget; Department of Natural Resources,” Ohio Legislative Service Commission, August 2011 (36).

Because the precipitous drop in funds between 2008 and 2011 almost entirely reflects the elimination of GRF funds to the Division of Geological Survey, OGS has rapidly grown more dependent on federal funds – the only funding component to have increased, albeit marginally, between 2010 and 2012. The shift to greater proportional reliance upon federal funding is shown in Figure 1, below.



While the Geological Survey has supplemented some of its lost GRF funding with new fees and grants, this manner of funding appears to produce minimal revenue. For instance, the Survey now charges small fees, mostly between \$10 and \$20 per hour, to view and use materials from its “core sample” library.<sup>6</sup> Attempts to interview ODNR representatives on details about the OGS funding structure were unsuccessful, and it is difficult to conclude exactly how much fee-based funding the Survey is able to generate. Geologists on the Ohio Geological Advisory Council, which acts as an external group of advisers to OGS, explain that the agency’s fee-based revenue is minimal, and mostly restricted to the H.R. Collins Laboratory (described below).

In short, the OGS budget shrank by 58 percent in the last decade – a reduction almost entirely attributable to the reduction and eventual elimination of the agency’s GRF funding. As a result the Survey is unable to perform activities once at the heart of its mission, as detailed below.

<sup>6</sup> The core sample library, housed at the H. R. Collins Laboratory, is an extensive collection of rock samples drilled from all around Ohio at multiple depths. Instead of drilling new samples to learn about Ohio’s sub-surface geological properties in any given area, professionals of various backgrounds can observe and even conduct tests on samples from this lab. OGS staff organizes and curates the core samples and other data in this lab, and assists interested parties in locating and handling the relevant samples.

## Functions of the Geological Survey

Interviews with geologists suggest that legislators and citizens tend to undervalue OGS's public benefit for two reasons. First, many assume that a few select industries such as oil and gas prospectors are the only regular users of OGS data. Second, they assume anything related to surveying geology is a one-time task undeserving of ongoing funding. Both views could be considered mistaken, as described below.

The Geological Survey makes ongoing contributions to public safety, energy security, and education, among other public services. Its efforts save other government agencies millions of dollars each year.

- Mapping: The Survey creates various types of maps that a wide range of industries use. Part of this process involves digitizing maps so that they are easily available to users. Mapping topics include: Bedrock Geology, Topography and Structure; Coastal Erosion; Environmental Geology (including ongoing mapping of abandoned underground mines and mapping of earthquake epicenters); Industrial Minerals; Lake Erie; Petroleum Geology; Surficial Geology (i.e. glacial deposits and other features of Ohio's surface geology); Miscellaneous Geology.
- Studies and Research Reports: OGS conducts research and publishes reports on the most pressing geological matters of the day. Recent or ongoing research topics include:
  - Contemporary geologic hazards such as sinkholes, landslides, earthquakes, and mine subsidence. Research on these topics is important for public safety as well as knowing where to construct new roads and buildings;
  - Other hazards such as radon and flooding;
  - 3-D mapping of Ohio's surface geology, which changes over time due to natural forces such as erosion;
  - Ohio's potential for geothermal energy, including integration of this data into a National Geothermal Data System;
  - Lake Erie coastal erosion, which, when unmitigated, threatens dozens of communities on Lake Erie's shore. Research can be used to prevent erosion, keep the public safe and preserve property;
  - Digital shoreline and beach monitoring. The boundaries of beaches are constantly moving, and understanding this cycle is key to understanding ecosystems, undertaking shoreline engineering projects, and even delineating political boundaries for legal purposes.<sup>7</sup> For instance, Ohio's portion of Lake Erie is a public asset owned by the state, whereas homeowners own most lakefront land in Northeast Ohio. Although this distinction may seem fairly straightforward, determining a precise legal boundary is difficult because of wind-induced tides and waves. Yet this once esoteric question has now become an important logistical matter in the effort to develop offshore wind turbines in Lake Erie. OGS is the only agency capable of collecting the data necessary to help resolve this issue;
- Convening the 'OhioSeis' network. This is a statewide network of 28 seismic stations that collect data and feed it into a central database. OGS is charged with coordinating this network and maintaining the data it produces;
- Maintaining the Horace R. Collins Laboratory. Located in Delaware, Ohio, this library houses the Ohio Geological Sample Repository as well as various other collections of maps, aerial photographs, and other data. The Ohio Geological Sample Repository consists of thousands of core samples that have been extracted from many layers of Ohio's underground geology at

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<sup>7</sup>Hossler, Lisa. "Ohio Supreme Court to Determine Legal Definition of Lake Erie Shoreline." *examiner.com*, Feb. 22, 2011, available at [www.examiner.com/article/ohio-supreme-court-to-determine-legal-definition-of-lake-erie-shoreline](http://www.examiner.com/article/ohio-supreme-court-to-determine-legal-definition-of-lake-erie-shoreline).

various points around Ohio and surrounding states. Organized maintenance and access to these materials is critical to a wide range of actors: The Ohio Department of Transportation and local governments use it when deciding where to build new roads, for example; developers use it to manage the financial risk of new construction, and fossil fuel industries use it heavily for prospecting and drilling. According to geologists familiar with OGS, most business owners wishing to expand their physical footprint or developers undertaking a new project must hire an environmental consultant, who will in turn often use data from the H. R. Collins Laboratory.<sup>8</sup>

According to the geologists we spoke with, OGS continues to conduct the above activities in some form at the time of this writing. Yet budget cuts are threatening the scope and longevity of many of these projects. For instance, OGS has stopped or limited its investigations of hazardous chemicals, formerly part of their Geologic Hazards program. Moreover, maintaining past levels of activity may be insufficient in light of evolving circumstances. Geologists and environmentalists have argued that the current seismic monitoring annual budget of \$20,000 is now unreasonably low given the fast-paced development of Ohio's shale oil and shale gas via hydraulic fracturing, or fracking (the relationship between OGS and hydraulic fracturing is discussed below).<sup>9</sup> Based on conversations with members of the OGS Advisory Council, it is our understanding that OGS has already ended or significantly reduced the following activities due to its loss of General Revenue Fund allocations:<sup>10</sup>

- Shale gas research, mapping, and data gathering. This work is useful in estimating the amount, location, and accessibility of shale oil and shale gas. It is also important in understanding risks of drilling;
- Reviewing state parks and other state land-use issues;
- Environmental reviews for land purchases. Conducting these reviews helps protect the public against hazards such as soil and water contamination or ecosystem destruction;
- K-12 educational outreach, such as providing teachers with resources to use while teaching about geology;
- The OGS newsletter, which currently is on indefinite hold;
- Assistance with Ohio State University capstone projects, which are necessary for many students to receive undergraduate or graduate degrees from OSU;
- Salt mine monitoring in Lake Erie. OGS has historically had regulatory jurisdiction over salt mines under Lake Erie. This authority includes legal review of mining leases, the responsibility of tracking production, and occasional research support for the industry. It is our understanding that these regulatory responsibilities still rest with OGS, yet a member of the OGS advisory committee said that these activities have been reduced due to budget cuts;
- Applied research and innovation on secondary oil recovery. Because an oil well becomes less productive after its initial phase, it is often not profitable for an oil company to extract the vast majority of oil that exists in a certain area (about 90 percent of the oil usually stays in the ground). Secondary oil recovery happens when oil companies go back to old sites and use

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<sup>8</sup> Conversation with Greg Kinsall, president of the Ohio Section of the American Institute of Professional Geologists, in July 2012.

<sup>9</sup> Conversations with Peter MacKenzie, recent member of the OGS Advisory Committee, in January 2012 and July 2012; conversation with Greg Kinsall, President of the Ohio Section of the American Institute of Professional Geologists, in July 2012.

<sup>10</sup> Conversation with Mark Rowland, chairman of the OGS Advisory Committee in July 2012; Conversations with Peter MacKenzie, recent member of the OGS Advisory Committee, in January 2012 and July 2012.

different techniques to extract some of the oil that was left behind the first time. Until recently, OGS conducted a number of studies and experiments to help the oil industry develop new methods of secondary oil recovery;

- Various types of research on coal and mining;
- Research on Ohio's potential for carbon sequestration, which may be an important strategy for reducing the negative impacts of global warming. OGS is still working on some ongoing carbon sequestration projects in surrounding states but has no new funding for such work in Ohio.

The wide breadth of this agency's functions makes it a great asset to the state. Its work is largely behind the scenes, but a wide range of industries and individuals benefit from the data it maintains and the research it conducts.

### **Who uses OGS data?**

Drawing from data OGS keeps on its own user trends, a recent study by Kleinhenz and Associates lists the industries that rely most heavily on OGS data:<sup>11</sup>

- Oil and gas (exploration and development), 25 percent of data requests;
- Higher education (college/universities), 17 percent;
- Environmental engineering/environmental consulting, 15 percent;
- Government (all levels), 13 percent
- Pipeline, 8 percent;
- Geotechnical consulting, 4 percent;
- Environmental non-governmental organizations, 3 percent;
- K-12 education, 2 percent;
- Coal industry, 2 percent;
- Individual homeowners, 2 percent;
- Insurance industry, 1 percent;
- Transportation infrastructure (roads and railroads), 1 percent;
- Regional planning, 1 percent;
- Public engineering, less than 1 percent;
- City planning, less than 1 percent;
- Economic development, less than 1 percent;
- Other, 13 percent.

### **Economic Impact**

The OGS is a prime example of an economic actor that produces what economists would call positive externalities. As with all public services, OGS does not profit from its own work, but its services provide public goods, ensuring that communities are safer and cleaner, helping homeowners understand threats to their property, and allowing private business and other government agencies to reduce costs.

OGS commissioned a consultant study to try to estimate the monetary contribution of its public services. The study uses two different methods.<sup>12</sup> Using survey data from 479 organizations and

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<sup>11</sup> Kleinhenz & Associates, "An Economic Impact Analysis of the Ohio Geological Survey's Products and Services," June 2011, available at <http://www.dnr.state.oh.us/Portals/10/pdf/Economic%20Analysis/EIA-Full-Report.pdf>.

<sup>12</sup> Ibid.

individuals, the study first estimated economic impact by calculating how much it would cost data users to replicate the OGS data on their own. The data replacement cost for the average project was found to be \$65,800. Given that OGS data contributed to about 8,740 projects in 2010, these figures indicate that OGS data could save users up to \$575 million per year. Even if savings were only a fraction of this estimate, the financial benefit to OGS users would still be quite significant. Part of these savings accrues to taxpayers in the form of savings to public education, universities, and other government agencies. The rest accrues to private business and nonprofits.

The second method is similar, but instead of asking for dollar values, the researchers asked OGS data users to estimate the percent by which total project costs would have increased if OGS data had not been available. The results indicated that average project costs would increase by 17 percent, yielding a total cost increase of \$1.5 billion per year among the 8,740 projects. Thus, the value of OGS data to those who use it can be estimated at somewhere between \$575 million and \$1.5 billion per year. By comparison, OGS received only \$1.05 million of GRF funding in 2010.

The above estimates do not include the multiplier effect of the money OGS spends on staff and other expenses, nor the impact of federal matching funds that USGS pays Ohio. Using input-output analysis, the Kleinhenz study estimates that this state and federal spending generates an additional \$5.7 million in sales for Ohio businesses each year.

### **OGS, hydraulic fracturing, and injection wells**

The Ohio Geologic Survey offers services important to the public good in the context of Ohio's developing shale drilling. The Survey creates maps, approves some types of drilling permits, conducts shale gas research, and monitors seismic activity. Moreover, oil and gas companies use OGS data both to research different areas for drilling potential and to assess groundwater availability and locate the large amount of water necessary for the process. Environmental consultants use OGS resources to sample water before and after drilling occurs, to test for contamination. While ODNR issues permits for injection wells, information from OGS informs part of that process.<sup>13</sup>

The Geological Survey's role as the convener of Ohio's seismic research network is also of growing importance as shale drilling increases. Large quantities of chemical-infused wastewater are a byproduct of hydraulic fracturing, and this wastewater may be stored underground in injection wells. Because Ohio developed the geological knowledge and obtained the federal permits for storing wastewater in injection wells a number of decades ago, injection wells in Ohio receive wastewater from surrounding states as well. However, in some instances, the injection of wastewater in these wells appears to cause earthquakes. ODNR recently concluded that the circumstances surrounding the recent series of earthquakes in and around Youngstown, Ohio, in 2011 make a "compelling argument" that the seismic activity was caused by injection wells.<sup>14</sup> A report from the U.S. Geological Survey arrived at an even more confident conclusion, stating that injection wells have "almost certainly" caused the recent spike in earthquakes across a number of states.<sup>15</sup> The budget cuts to OGS are therefore especially unfortunate given that OGS is the agency in Ohio responsible for monitoring seismic activity. As noted in ODNR's study of injection wells, the Survey's lack of

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<sup>13</sup> Conversation with Greg Kinsall, president, Ohio section of the American Institute of Professional Geologists, July 2012.

<sup>14</sup> Ohio Department of Natural Resources, "Preliminary Report on the Northstar 1 Class II Injection Well and the Seismic Events in the Youngstown, Ohio Area," March 2012 (17).

<sup>15</sup> Kuykendall, Taylor, "USGS Study: Human activity 'certainly' cause of increased seismic activity." *The State Journal*, April 6, 2012. Available at <http://bit.ly/I8ex5G>.

capacity has created problems for properly monitoring recent seismic activity likely related to injection wells:

*With only one seismometer deployed in the Youngstown area, state geologists lacked the necessary data on the earthquakes' depth and exact location to draw a direct correlation between the seismic events and the deep injection well.*<sup>16</sup>

State geologists were able to understand more about the likely causality between injection wells and earthquakes only after borrowing seismic monitoring equipment from other states.

Properly funding the Ohio Geological Survey would be a necessary component of the regulatory infrastructure necessary for ensuring that hydraulic fracturing in Ohio does not cause major human and environmental damage.

## Conclusion and recommendations

The Ohio Geological Survey is a small agency that provides enormous public benefit. Its research helps us prepare for and mitigate hazards including sinkholes, global warming, floods, erosion, and landslides. Its data also allow us to plan where to build new roads and buildings. Without public access to OGS data, scores of construction projects would cost more to taxpayers, and others would be too risky or expensive to justify in the first place. Moreover, the data OGS gathers and maintains contribute to the general body of scientific knowledge, and is used heavily by educators and students at all levels.

Mark Rowland, the chairman of the Ohio Geological Advisory Council, sums it up concisely: The great value of OGS lies in its consistency and its unbiased approach. Individual companies cannot maintain the decades and even centuries-long consistency necessary to curate the expansive databases OGS maintains. As a government agency, OGS is not beholden to any specific industry or other special interests, but is staffed by career geologists whose professional commitments are to sound science.<sup>17</sup>

Instead of continuing down its destructive path of service evisceration, Ohio should look to neighboring West Virginia's funding structure of its Geological Survey for a policy model. Funding for the West Virginia Geological Survey has grown in recent years, including a 47 percent increase from 2011 to 2012. Despite the fact that West Virginia has a population that is less than a sixth of Ohio's, the West Virginia Geological Survey received more than four times as much state funding as OGS in 2011, and was budgeted to receive over six times more than OGS in 2012.<sup>18</sup>

While the Ohio Survey may be able to create some new revenue by more effectively leveraging its incredible value to private industry, much of its data is considered a public resource. For this reason, and because of the important public benefits described above, Ohio's legislature should restore GRF funding to the Division of Geological Survey and provide adequate resources to address the new challenges of the pending drilling boom.

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<sup>16</sup> Ohio Department of Natural Resources, "Preliminary Report on the Northstar 1 Class II Injection Well and the Seismic Events in the Youngstown, Ohio Area," March 2012 (3).

<sup>17</sup> Conversation with Mark Rowland, Chairman of Ohio Geological Advisory Council, July 2012.

<sup>18</sup> State of West Virginia Executive Budget, Fiscal Year 2013, vol. 2 (250), available at <http://bit.ly/O1LNud>.