BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of a Working Case to Consider Policies to Improve Electric Utilities Regulation	)))	**Case No. EW-2016-0313**

ADDITIONAL COMMENTS OF THE OFFICE OF THE PUBLIC COUNSEL

COMES NOW the Office of the Public Counsel ("OPC" or "Public Counsel") and offers the following the additional written suggestions regarding possible ways the Public Service Commission ("Commission") may improve the way they regulate electric utilities based on information and presentations contained within the Workshop held on September 13th of this year as follows:

While OPC was given the opportunity to submit reply comments to the interested stakeholders Initial Comments, the office believed its original filing spoke sufficiently to our concerns and none of the other Initial Comments required reply as the parties involved sufficiently presented their view point on the issue and there was no material that demanded reply from our perspective.

At the September 13th workshop, there were a number of additional interesting and provocative ideas presented by all parties. OPC believes the workshop was a productive and useful venue to have these ideas presented and discussed; some healthy debates as well. One issue that was not discussed in length that OPC wishes to address is the tremendous amount of environmental costs that are coming down the pipe as the result of federal regulations. This is going to result in a tremendous amount of money borne by the ratepayer and has nothing to do with distribution – the sole topic of this docket. We offer commentary on this as well as supplemental material for the Staff's review in anticipation of their report.

Also, the OPC endorses proposals offered by the Public Service Commission Staff ("Staff") in regards to increasing and enhancing surveillance monitoring. Currently, OPC has nothing to offer in regards to amending or expanding upon this proposal but encourage future conversation. Finally, OPC wishes to expound upon interest in further discussions of interim rates. We believe this is a worthwhile pursuit as long as there is an effort to also include discussions of interim rates in the event a complaint is filed by those parties statutorily entitled to do so.

As a *caveat*, we do not offer these thoughts to negate or rescind our previous comments or to backtrack from any of the productive and ongoing conversations OPC is conducting with interested stakeholders. We only reference these matters in order to give Staff a total picture of these issues.

Environmental Costs and Fading Trends

As already discussed in the Introduction, the sole focus of this of this docket is on distribution – methods, costs, and the much-ballyhooed "reform" needed. But distribution costs cannot be viewed in a vacuum. Ratepayers are going to get hit with lots of costs for the "sins" of our past use of coal to produce energy as the federal government has deemed. Streamlining grid costs to put up technology that may or may not get fully utilized is an irresponsible use of a finite amount of money. Think about the following: Ameren Missouri ("Ameren") said two years ago publically that the Clean Power Plan ("CPP") will cost ratepayers $4 billion. Two weeks ago, the *St. Louis Post-Dispatch* ran a story about the circuit courts upcoming $1 billion dollar ruling on Rush Island.[1] It should be noted that ruling has not been made in this case as of the writing of these comments. Ameren's IRP says they have of $1.8 billion in known environmental costs.

[1] http://www.stltoday.com/business/local/judge-to-decide-whether-ameren-will-install-billion-in-pollution/article_f778d74b-9384-5baf-bd78-e714394a1c55.html

None of those billion dollar projections overlap. Moreover, this doesn't take into account experimental solar projects that have a tenuous basis for existence, MEEIA windfall profits, and electric vehicle (EV) charging stations. To repeat, this is a matter of billions of dollars.

Consider the documents attached to these comments. First, is the relevant portion of Ameren's *Integrated Resource Plan Update//Spring 2016* that speaks to the "considerable uncertainty" with the CPP in its current legal state.

There is also Ameren's *EPA's Proposed Greenhouse Gas Rule* Power Point slide dated August 18th, 2014. In this, Ameren describes federal mandates to reduce carbon dioxide in existing power plants by 2030 with benchmark requirements coming much sooner. This is significant in Missouri as the American Society of Civil Engineers' *2013 Report Card for Missouri's Infrastructure* highlights our state's energy infrastructure is "81 percent" of the energy in this state is produced by coal. While this report discusses improvements to the distribution system, it also notes environmental costs will "likely be passed along to the customer and drive up energy costs." It should be noted Ameren articulates difficulty coming up with a plan under these conditions. OPC understands this concern but is uncertain as to why it and the other investor-owned utilities seek reform that has the potential to cause more costs for ratepayers as well as increase the level of complexity faced by lawmakers and policymakers.

Of further relevance, while not addressed by these documents, more uncertainty is guaranteed by the fact we have a Presidential election coming up in November of this fall as well as a gubernatorial transition. For this state to make substantial changes in light of this inevitable federal shift and change in executive leadership (no matter which direction) will result in policies that do not reflect the reality of the total regulatory landscape.

Finally, OPC also offers *The Economist's* "Where the Smart Is: Connected Homes Will Take Longer to Materialise[2] than Expected" from June 11th, 2016. While all sorts of "smart" devices are touted by utility executives and consultants, the reality is 72% of consumers have *no plan* to adopt smart-home technology. Further, only 15% of consumers will adopt said technology by 2021. The article offers the anecdotal evidence that a "smart fridge" sells for a "cool" $5000. One would have to speak of incredible energy cost savings to remove this from the prohibitive section of most families' budgets.

Several parties engaged in this process want to streamline our regulations for a smart grid without any details. In all of this talk about regulatory lag, lawmakers and policy makers have lost touch with these significant and potentially draconian costs coming down the pipe.

Surveillance Monitoring

With little additional commentary, OPC supports Staff's proposal to increase and enhance surveillance reports and welcome additional discussions on this matter.

Interim Rates

One potential solution to the perceived problem of "regulatory lag" addressed in the workshop was developing "interim rates" during rate cases. OPC is supportive of discussing these ideas as long as there was also a requirement for interim rates during a complaint case. The clear concern being how an investor-owned utility will recover those if the complaint were not warranted. That will require further work and research.

OPC conducted research seeking out a fifty-state survey (and District of Columbia), and found[3] there are 45 that have some form of interim process for rate increases. Of the 45 states,

[2] British spelling

[3] http://www.michigan.gov/documents/energy/Additional_Questions_4-6_response_from_DTE_Consumers_and_MEGA_420067_7.pdf

nine allow for interim increases on a fairly regular basis. This is one approach to address regulatory lag. Nine of the states allow interim increases automatically after specific periods of time have passed. Five states allow interim increases after commission approval, and have done so regularly. One of the states allows for final rates to go into effect, subject to refund, after seven months. 21 of the states allow interim increases only in the case of an emergency or severe financial stress. Allowing rates to go into effect earlier than the final decision is common among states and is one example of how states have tried to address issues associated with regulatory lag. [4]

There are many other approaches used by states, as discussed in a 2011 report prepared for the EEI by Pacific Economics Group Research LLC, entitled, *Innovative Regulation: A Survey of Remedies For Regulatory Lag*. The issue of regulatory lag has been a topic of considerable discussion among state policy makers and the industry in recent years. This is due in part to overall economic conditions and the need to invest in and update electric generation, transmission, and distribution facilities in order to secure long-term reliability of the nation's electric system and address other issues, such as environmental requirements and integration of renewable energy.

Conclusion

The OPC believes there is great benefit to a continued conversation on improving electric regulation and including considering interim rates as well as improvements to the surveillance reporting requirements. However, we further caution that there are significant environmental concerns in the near future that have the potential for incredible increases

[4] https://www.efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=935593343

in electricity bills for ratepayers. Easing regulatory lag and speeding up the process for investor-owned utilities will only accelerate and amplify these rate increases.

Again, as we did in our Initial Comments, OPC would also urge the Commission – if it intends to significantly reform electric ratemaking cases – to issue a moratorium on such cases until a new approach is finalized.

WHEREFORE the Office of the Public Counsel submits these Comments.

Respectfully,

OFFICE OF THE PUBLIC COUNSEL

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CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing have been mailed, emailed or hand-delivered to all counsel of record this 23rd day of September 2016:

/s/ James M. Owen

INTEGRATED RESOURCE PLAN UPDATE // SPRING 2016

Ameren MISSOURI

FOCUSED ENERGY. For life.

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Table 3.3: Environmental Mitigation Costs (2016$)[7]

Facility	Environmental Mitigation	Regulation	Cost $Million	Fixed O&M $Million	Var O&M $/MWh
Meramec	Ash Pond Closure	CCR	49	-	-
	Activated Carbon	MATS	15	0.1	0.5
	NPDES Permit & Groundwater Monitoring	CWA	1	0.1	-
Meramec	Total Environmental		65	0.2	0.5
Labadie	Ash Pond Closure	CCR	46	-	-
	Landfill Cell	CCR	66	-	-
	Dry Ash Conversion	CCR	98	-2.7*	-
	Water Treatment Plant	ELG	26	0.4	-
	ESP Upgrade	MATS	24	-	-
	Activated Carbon	MATS	20	0.1	0.9
	FGD	CSAPR	519	6.5	0.6
	Cooling Tower	CWA 316 (a)	166	1.4	0.7
	Fine Mesh Screens	CWA 316 (b)	19	-	-
	NPDES Permit & Groundwater Monitoring	CWA	2	0.1	-
Labadie	Total Environmental		988	8.6	2.2
Rush Island	Ash Pond Closure	CCR	33	-	-
	Dry Ash Conversion	CCR	75	-0.6*	-
	Pad & Canopy for Ash Staging	CCR	5	-	-
	Water Treatment Plant	ELG	23	0.3	-
	Activated Carbon	MATS	7	0.1	0.3
	Fine Mesh Screens	CWA 316 (b)	18	0.2	-
	NPDES Permit & Groundwater Monitoring	CWA	2	0.1	-
Rush	Total Environmental		161	0.7	0.3
Sioux	Ash Pond Closure	CCR	25	-	-
	Landfill Cell	CCR	71	-	-
	Dry Ash Conversion	CCR	82	.2*	-
	Water Treatment Plant	ELG	22	0.3	-
	SCR	NAAQS - Ozone	232	0.8	0.6
	Fine Mesh Screens	CWA 316 (b)	11	0.1	-
	Mercury Addition	MATS	2	0.1	0.2
	NPDES Permit & Groundwater Monitoring	CWA	2	0.1	-
Sioux	Total Environmental		446	1.4	0.8
Total	Total Environmental		1,659	10.8	3.8

* Incremental cost(+)/savings(-)

[7] EO-2016-0037 c (1)-(12)

3.1.4 Clean Power Plan (CPP)[8]

Considerable uncertainty remains with respect to the outcome of the legal proceedings on the rule and how that might impact the form and timing of final regulations for GHG emissions from existing power plants known as the Clean Power Plan. The U.S. EPA released the final CPP rule for existing sources in August 2015. In February 2016, the U.S. Supreme Court issued a stay of the rule pending review by lower courts of various legal challenges to the rule. As a result of the stay, many state governments have suspended or have planned to suspend significant further actions to implement the rule unless and until the stay is lifted. Ameren Missouri has been working with the Missouri Department of Natural Resources, affected Missouri generators and other stakeholders to consider various approaches for how Missouri should craft its state compliance plan should the CPP be found to be legal.

Background

The Clean Power Plan was published in the Federal Register on October 23, 2015 and became effective December 22, 2015. The CPP establishes for the first time Green House Gas emission limits for new power plants and emission guidelines for existing power plants. The rules are designed to achieve significant carbon dioxide emission reductions from the utility power sector. The EPA projects the existing source rule will result in a 32% reduction in CO_2 levels from the utility sector by 2030 from a reference year of 2005. The rule will require CO_2 reductions that will be phased in over the period 2022-2029 with the final target to be achieved by 2030.

Each state with affected sources is required to develop a state compliance plan which will describe how the state will achieve the targets required by the rule. The state's final plan is required to be submitted by September 6, 2016. If the state believes it will be unable to complete a final plan by that date, it can submit an initial plan and request a two year extension in filing its final plan. If granted by the EPA, the state would have until September 6, 2018 to file its final state plan.

A number of parties have requested that EPA reconsider the final rule. EPA has yet to rule on those requests. In addition, a number of states and other organizations filed challenges to the rule and requested a stay of the final rule with the D.C. Circuit Court. The D. C. Circuit denied the stay petition on January 21, 2016. On January 26, 2016, numerous parties including Missouri appealed the D. C. Circuit Court stay petition denial to the U. S. Supreme Court. The Supreme Court granted the stay petition on February

[8] EO-2016-0037 g

9, 2016. The formal hearing of the case in the D. C. Circuit Court will continue despite the granting of the stay by the Supreme Court. The D. C. Circuit Court has begun the process of reviewing the vacatur request from numerous parties to the case on an expedited schedule. Oral arguments are scheduled for June 2, 2016.

It is expected the legal process will continue through most of 2016 with a ruling not expected until late 2016. It is also expected that regardless of the ruling certain parties will appeal the Court's decision to the U.S. Supreme Court for their consideration. That process could take at least a year if the Court decides to hear the appeal.

The rules for new, modified and reconstructed units have also been challenged in the DC Circuit Court of Appeals. Petitioners must file their brief by July 15, 2016. Oral argument is expected approximately 45 days following the final brief filings due on November 14, 2016.

Current Activities

In February, Ameren Missouri, along with regulators, other utilities and other stakeholders, participated in a workshop to consider various questions and issues regarding Missouri's approach to the CPP and their implications. Ameren Missouri filed its responses to these questions on February 1, 2016. Likewise, Ameren Missouri has prepared responses on a number of questions raised in the Commission's order on special contemporary issues. Following are those questions and our responses.

Describe how the preferred plan of the Company's last and current annual or triennial Integrated Resource Plans (IRPs) positions the utility for full or partial compliance with the U.S. Environmental Protections Agency's (EPA) Clean Power Plan (CPP) under Section 111(d) of the Clean Air Act, as released in final form on August 3, 2015.

Considerable uncertainty remains with the CPP and its implementation. Specifically, legal challenges regarding the CPP have been filed which, if successful, could lead to material changes in the final rule. The stay issued by the U.S. Supreme Court is expected to result in further delay of the implementation of the rule. As a result, the extent to which Ameren Missouri's preferred resource plan positions the Company for partial or full compliance with the CPP is unclear. That said, the Company continues to work to ensure that it is prepared to meet the requirements of the final form of the regulations by identifying and implementing elements of the preferred resource plan and resource acquisition strategy, including contingency plans, which are likely to support partial or full compliance. Such actions include the continuation of successful energy efficiency programs, the addition of new renewable resources, and the identification of potential sites for gas-fired combined cycle generation. Ameren Missouri also continues

to review investments in and operation of our existing generation assets to support the transition of our fleet to one that is cleaner and more fuel diverse in a responsible fashion, consistent with our generation strategy.

Include an evaluation of how renewable energy, energy efficiency and other demand-side resources (including combined heat and power) deployed by the Company after January 1, 2013, could contribute to compliance.

Ameren Missouri's existing and planned renewable resources and energy efficiency programs will contribute to compliance with the CPP in Missouri by displacing or continuing to displace the need for generation from affected sources under the CPP.

Include an evaluation of how renewable energy and energy efficiency and other demand-side resources (including combined heat and power) deployed by the Company after the submission of a final State Implementation Plan could qualify under the EPA's proposed Clean Energy Investment Program (CEIP).

Under the proposed CEIP, qualifying renewable resources and low-income energy efficiency programs could be eligible for additional emission allowances under the CPP. Qualifying resources must be initiated after submittal of the state's final CPP implementation plan. Under the proposal, renewable generation (or energy efficiency savings) achieved in 2020 and 2021 would be eligible for credits; the credits would be available from a pool that includes credits from the state's allowance allocation and matching credits from the EPA.

Ameren Missouri has not yet determined a compliance plan for the CPP, largely because Missouri has not yet settled on an approach for a state implementation plan. However, any modifications to our current IRP preferred plan will consider all options available and will be designed to satisfy the compliance requirements of the state implementation plan in a manner that most effectively maintains affordable and reliable service to our customers. Such considerations will include the CEIP, recent changes to tax incentives for renewable generation (ITC/PTC), as well as other relevant factors.

Include a description of additional investments which will be required by the Company to meet the targets in the CPP under scenarios including: a statewide rate-based or mass-based emissions goal; a "trading-ready" approach; and participation in the CEIP.

Ameren Missouri does not currently have reliable estimates for the investments that may be required to comply with the final form of the CPP and Missouri's state implementation plan due to the great uncertainty as to the timing and final form of the

rule. However, Ameren Missouri believes that the state's goal should be to achieve compliance with the CPP's targets in an affordable manner while maintaining the reliable service Missouri customers expect. Ameren Missouri supports a mass-based compliance approach for Missouri that allocates allowances to all affected sources based on a historical multi-year baseline. In order to provide certainty that is critical in resource and compliance planning, Ameren Missouri supports allowance allocations that are permanent and irrevocable, regardless of whether a unit retires or is operational, and does not support the auctioning of allowances as it could result in higher costs to customers.

Ameren Missouri believes that the CEIP should be structured as a pure incentive program for early action and as such the EPA should not require the state to set aside allowances from its allocations for participating in the CEIP. Instead, the incentive should come from additional federal allowances that are provided by the EPA and not from state allowance budgets.

Describe the barriers to achieving these additional investments.

Because the nature, extent and timing of investments are highly uncertain, it is not clear what barriers may need to be overcome.

Note the price of carbon used by the Company in the analyses described above.

Because of the continued high level of uncertainty regarding the final form of the rule and the timing of implementation, no such analysis has been performed. The Company's 2014 IRP filing indicates a range of carbon prices used for its previous analysis, and a comparison of those assumptions to more recent external sources is included in Section 3.4.

Provide an indication of the Company's preferences regarding various compliance options under a state implementation plan.

In order to develop a cost effective and reliable compliance plan for our customers to meet the requirements of the final CPP, Ameren Missouri would consider additional cost-effective energy efficiency programs, new renewable resources, allowance purchases, new natural gas fired generation and any other compliance elements included in the state plan.

EPA's Proposed Greenhouse Gas Rule

August 18, 2014

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On June 2, the EPA released its proposed "Clean Power Plan"

- The proposed rule establishes carbon dioxide (CO_2) emissions performance standards for existing power plants under Clean Air Act section 111(d).
  - A national requirement by 2030 of reducing CO2 emissions from the power sector by 30 percent from 2005 levels, with significant reductions, via very aggressive interim targets, beginning in 2020.
  - Final rule expected by June 2015.
  - States must develop implementation plans by mid-2016 or, if they choose to participate in a multi-state plan, by mid-2017(with possible 1 year extensions).
  - Emission limits encompass the entire electric grid, not just emission sources (i.e., power plants).
  - 2012 was used as the baseline year to establish state level emission rate targets…action taken prior to 2012 is included in the baseline and not credited toward achieving the target rate
  - Actions taken between now and 2020 are only credited if they result in CO2 reductions after 2020

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On June 2, the EPA released its proposed "Clean Power Plan"

- EPA issued guidelines on what constitutes "Best System of Emissions Reduction" (BSER)
- Each State is required to develop a plan to comply with EPA's BSER rate
- EPA's determination of BSER is made up of four "building blocks".
  1) Improvement of power plant efficiency – assumed 6% improvement achievable
  2) Use of "environmental dispatch" vs. economic dispatch, whereby existing natural gas-fired combined cycle (NGCC) plants are utilized more and coal-fired plants less – assumed NGCC units increase operation to 70% capacity factor
  3) Expanded use of low and zero-carbon generating capacity – assumed increase in Missouri renewable generation from 1.3 million MWh to 2.8 million MWh by 2029, assumed continued operation of 6% of nuclear fleet, "at risk" generation
  4) Expanded use of demand-side efficiency – assumed 1.5% increase in penetration of EE annually and a cumulative 9.92% of electricity sales in 2030
- State can decide to comply on a rate or mass (tonnage) basis as well as join other states in establishing regional compliance plan

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Ameren Missouri has a plan to responsibly transition our generating fleet to a cleaner and more diverse portfolio

- Ameren Missouri is executing a plan we have been working on for years, in conjunction with our Integrated Resource Planning (IRP) process, to transition our generation fleet to a cleaner and more diverse portfolio in a responsible fashion. This plan is focused on several key objectives:
  - Optimizing use of existing low cost coal plants by retiring them at the end of their useful lives.
  - Continuation of significant energy efficiency programs.
  - Adding additional levels of renewable energy to meet Missouri's Renewable Energy Standard.
  - Adding natural gas combined cycle generation to the portfolio.
  - Maintaining the option for nuclear generation.
- Our 2014 IRP will be filed with the Missouri PSC in October 2014.

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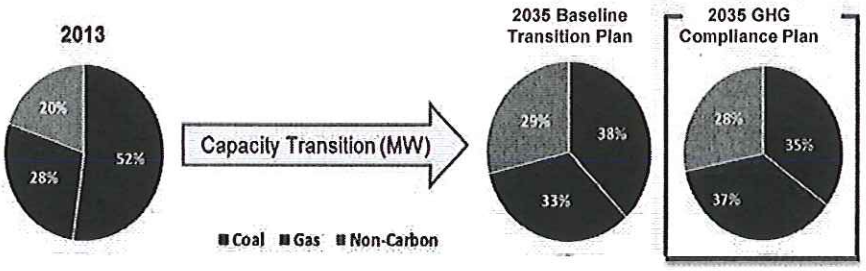
Our baseline transition plan results in dramatic changes to the fuel diversity of our generation fleet and to our carbon footprint

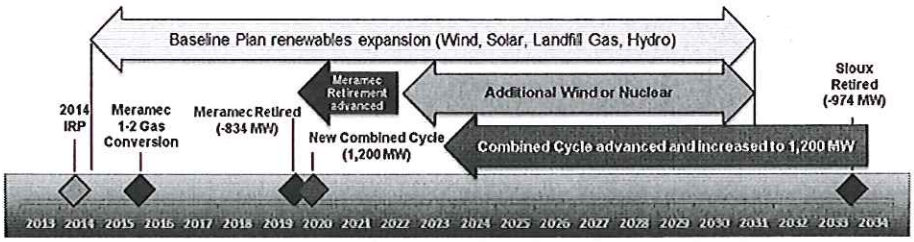
Baseline Transition Plan

- Balanced fuel mix within 20 years
- Annual CO2 reductions equivalent to the EPA plan by 2035
- Responsible and managed transition with minimal risk, cost and reliability impacts

GHG Compliance Plan

- Similar fuel mix to Baseline Plan
- Costly earlier coal retirements
- Unneeded acceleration and addition of gas-fired combined cycle generation by 2020
- Additional capacity reserves not needed for customer demand or RTO reliability requirements
- Uneconomic dispatch resulting in significantly higher net fuel costs to customers





Retaining option for Nuclear generation

Compared to the Baseline Transition Plan, the GHG Compliance Plan results in significantly increased costs to customers

The GHG Compliance Plan results in reliability concerns and significant increased costs to customers estimated at this time to be approximately $4 billion over the next 20 years

- This $4 billion increase in costs to our customers to comply with the GHG rule is being driven by:
  - capital expenditures to build more capacity than we would build under our baseline transition plan,
  - building capacity years ahead of when it is needed to serve customers, and
  - uneconomic dispatch of natural gas vs. coal capacity.
- On a net present value basis compliance with the proposed GHG rule would cost our customers about **four times** what it would cost them under our baseline transition plan.
- Compliance with proposed GHG rule would cause significant rate increases by 2020.

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In addition to the cost impact on consumers we believe the EPA's proposal is based on flawed assumptions

- EPA's building blocks contain flaws associated with how the emission rate targets were calculated:
  - Additional generation plant efficiency improvements of 6% were assumed where realistically only about 1 to 2% percent may be achievable on Ameren's system, and at significant costs.
  - Combined cycle gas utilization ("environmental dispatch") is assumed to be 70% which is not economic when compared to the current dispatch of the system and assumes firm natural gas pipeline capacity reservations are available.
  - The EPA's baseline calculations include overly aggressive assumptions on customer energy efficiency programs.
- The proposed rule is fraught with legal issues that will result in numerous lawsuits. This will create additional financial and operational risks and uncertainties.

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Recommended Changes to EPA's Proposed Clean Power Plan

- States should be given flexibility to implement the rule, including establishing reasonable milestones that provide a glide path toward the final emission goal that is reflective of individual state conditions, instead of EPAs interim targets (2020-2029).
- Credits should be provided in the rate-based calculation for shutting down coal plants that are not replaced. These units should be treated as a zero-emitting resource similar to the way energy efficiency is treated.
- Missouri should be allowed to extend the compliance date in order to allow for orderly retirement of coal plants.

With these adjustments we can execute our baseline plan and reach EPA's ultimate emissions reduction targets without imposing unnecessary high costs on consumers or significantly impacting Missouri's economy.

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Conclusions

- For many years, Ameren Missouri has been taking steps to address the climate issue with the goal of transitioning our fleet to a cleaner and more diverse portfolio.
- Ameren Missouri has a Plan that can ultimately reduce CO2 emissions to the same levels targeted by EPA.
- Ameren Missouri's plan does take about 5 years longer, but it will save our customers $4 billion over what they would have to pay under the EPA's proposed rule.
- Ameren Missouri's plan helps mitigate the negative impact of the EPA's proposed rule on our customers, especially low/fixed income customers, on reliability, and on the economic competitiveness of our region.
- We will continue to work in a constructive fashion with key stakeholders, including the EPA, to develop energy policies for the benefit of all our stakeholders and the environment

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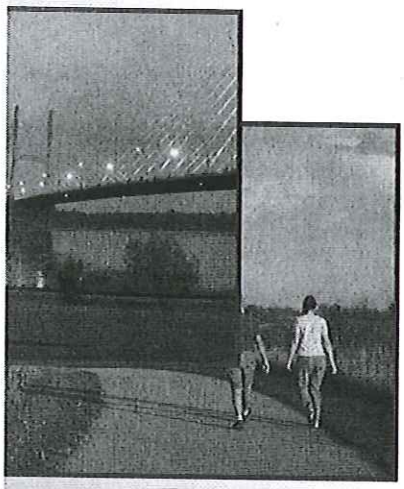
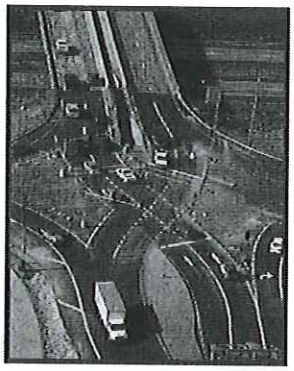
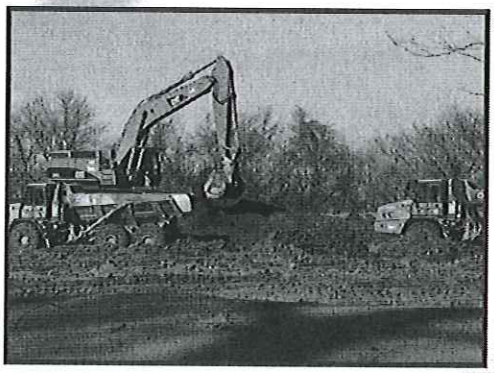
2013 REPORT CARD FOR MISSOURI'S INFRASTRUCTURE







ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

EXECUTIVE SUMMARY

BACKGROUND AND METHODOLOGY:

Infrastructure is the backbone of the state's economic and social activity. On any given day we engage in the use of infrastructure in all of our daily activities. From the water we drink, to the roads we drive on, to the energy that heats and cools our homes and powers our computers, to the schools in which our children are educated; we are completely dependent on the infrastructure that provides these necessities. Although they often go unnoticed, elements such as reliable power, efficient transportation, and safe schools provide quality of life and drive our economic engines as they attract business and allow it to prosper. The central location of the state of Missouri gives our infrastructure a unique importance as the crossroads of several interstate highways, rail systems and two major inland waterways intersect in our state.

With this in mind, engineers from the Kansas City and St. Louis Sections of the American Society of Civil Engineers (ASCE) came together to grade the infrastructure for the entire state of Missouri and raise awareness of the need for continued funding and maintenance of these essential facilities. This report provides a state perspective of the 2013 Report Card for America's Infrastructure that the reviews the nation's infrastructure. Find out more at http://www.infrastructurereportcard.org/missouri/missouri-overview/

Technical committees reviewed existing reports and inventories of the nation's infrastructure and discussed the current condition and funding levels with public officials. All available information was used to summarize the current state of the infrastructure and a composite grade was awarded based on individual grades for the following criteria:

- **Capacity:** The measure of the infrastructure's capacity to meet current and future demands
- **Condition:** The existing physical condition of the infrastructure
- **Funding:** The current level of funding of each infrastructure type compared to the estimated funding need
- **Future Need:** The cost to improve infrastructure to an acceptable level
- **Operation and Maintenance:** The measure of the owner's ability to operate and maintain the infrastructure properly and within government regulations
- **Public Safety:** The extent to which the public's safety is jeopardized by the condition of the infrastructure and the consequence of failure
- **Resilience:** The infrastructure's capability to prevent or protect against significant multi-hazard threats and incidents

The report card utilizes a 10-point grading scale, similar to a traditional school report card. Each of the seven grading components was assigned a grade as follows:

90-100 = A
80-89 = B
70-79 = C
51-69 = D
50 or Below = F

RESULTS:

Eleven different categories of infrastructure for the state of Missouri were evaluated and graded. They are summarized in the following table:

Infrastructure Category	Grade
Aviation	C
Bridges	C-
Dams	D-
Drinking Water	C-
Energy	D+
Inland Waterways	D
Levees	C-
Railroads	C
Roads	C
Schools	C
Wastewater	C-
Overall	**C-**

Overall the infrastructure for the state of Missouri receives a C- grade. It is the hope of ASCE that this evaluation can be used by citizens, and public officials to:

- Raise awareness about the significance of infrastructure to our daily lives;
- Highlight the importance of efficient operation and maintenance of the state's critical infrastructure; and
- Provide a starting point for discussion about the importance of continued funding to maintain and improve the condition of the state's infrastructure.

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- Tom Jacobs, P.E., CFM – Co-chair
- Chad Schrand, P.E. – Co-chair
- Alex Darby, P.E. – Co-chair
- Steve Lackey, P.E. – Subgroup Leader
- John Dowell, P.E. – Subgroup leader

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D+

ENERGY

RECOMMENDATIONS:

- Provide a clear statewide energy policy including potential sources of energy generation, goals for make-up of the future generation sources and the transmission (delivery) systems required.
- Provide for maintenance and retrofit to existing facilities, specifically the aging generation and transmission infrastructure.
- Invest in the research of alternative energy and advanced nuclear energy sources to diversify the energy generation sources within the state.
- Remove any unnecessary permitting hurdles that delay needed projects.
- Create proper incentives to catalyze the generation and transmission investments.

EXECUTIVE SUMMARY:

Missouri is unique in that it is a member of three power distribution networks. Approximately 81 percent of the energy in Missouri is produce through coal power plants with another 12 percent being provided through nuclear energy; the remainder of Missouri's energy needs are meet through natural gas, hydroelectric and wind generation. Aging infrastructure and government regulation continue to be major drivers for large expenditures at both the power plants and in the distribution system. Energy prices in Missouri are currently very affordable; however due to a projected $107 billion dollar national shortfall in funding, additional costs will likely be passed along to the customers and drive up energy costs. A clear plan for energy development should be developed for the state to help improve the current grade of "D+".

BACKGROUND:

Energy and transmission infrastructure in North America is divided into several networks. These networks separate the infrastructure into geographical regions which are then managed by Independent System Operators (ISO). The ISO's are responsible for supplying the country with efficient and reliable energy. Missouri is part of three ISO networks: Southwest Power Pool (SPP), Midwest Independent Transmission Systems Operator (MISO), and Southeastern Electric Reliability Council (SERC).

The nation's energy is primarily generated from four different types of fuel: coal, gas/oil, nuclear, and renewables. Gas and oil are the predominant fuels in the SPP system, while coal is the predominant fuel in the MISO and SERC Systems. Missouri relies principally on generation from coal. Missouri relies on many miles of transmission lines that are in aged condition and were originally arranged to support local needs instead of regional needs. Due to these dynamics, Missouri power producers are facing uncertainties related to fuel cost variability, environmental regulations, land acquisition restrictions and growing load demand. Increased investment in generation facilities and transmission distribution networks is needed to maintain a reliable power system.

ENERGY MAKEUP:

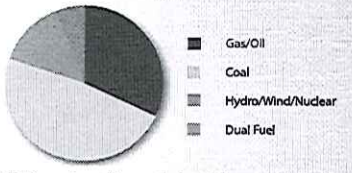
Missouri has large coal fleet. These coal plants are aged and will continue to need maintenance and upgrades. Missouri does not have a viable coal, petroleum or natural gas reserve in the state. Although a large amount of coal is located in the state, it is not considered viable due to its high sulfur content. Missouri receives a substantial portion of its coal from Wyoming via rail car. Most of the coal, gas, and petroleum consumed in the state are imported from other states. Coal accounts for nearly 81 percent of Missouri's generation. Major pipelines cross the state, providing the means of transport for these resources into the state. Nuclear energy generation accounts for nearly 12 percent of Missouri's power generation today. This nuclear energy is provided by a lone source, Callaway nuclear plant. Natural gas, hydroelectric and wind generation account for less than seven percent. Most of this renewable generation can be attributed to hydroelectric generation.

Missouri does not participate in capping greenhouse emissions. Missouri does not have any regional memberships to organizations evaluating or working on capping measures. Missouri has adopted a renewable portfolio standard that requires investor-owned utilities to deliver renewable generation of five percent, 10 percent and 15 percent total output by 2014, 2018 and 2021 respectively. This renewable standard will require investment in renewable infrastructure or means to purchase reliable renewable energy from other states, creating a need for upgraded and new transmission.

INVESTMENT PLANNING:

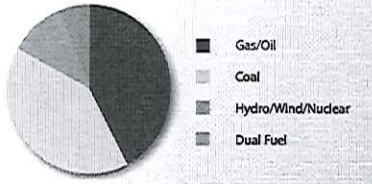
Missouri has a unique power network, containing three regional entities, the SPP, MISO and southeast pool. The SPP, MISO and southeast pool are responsible for maintaining their respective infrastructure and charting unique paths forward, dependent on their regional needs.

SPP



In the SPP region, the anticipated growth in the upcoming years is forecasted to be roughly 1.16 percent annually. As of 2010, the SPP generation portfolio consisted of the following breakdown: gas/oil (42 percent), coal (40 percent), hydro/wind/nuclear (11 percent), dual fuel (6 percent).

MISO



Midwest ISO growth is forecasted to be 0.75 percent (per year). As of June 2012, the MISO generation portfolio had a capacity of 131,581 MW and consisted of the following breakdown: gas/oil (32 percent), coal (48 percent), Renewables (wind and hydro) (14 percent), nuclear (6 percent).

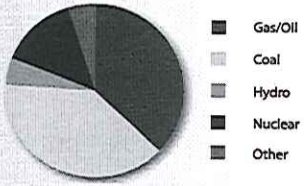
One of the challenges for MISO is the aging

D+

ENERGY

generation plants, where the average age of coal plants more than 40 years old. If current trends continue, these aged plants will require upgrades and environmental retrofits, requiring substantial investment. This issue is compounded by the potential effects on the generation capacity due to carbon legislation and the number of states implementing renewable portfolio standards within the MISO footprint.

SERC Generation Portfolio



As of June 2011, the SERC regional capacity was 247,943 MW and consisted of the following breakdown: coal (39 percent), gas/oil (37 percent), nuclear (14 percent), hydro (5 percent), and others (5 percent). Peak energy demand is expected to grow by 1.43 percent annually through 2020. Future load generation growth is projected to be primarily in the nuclear market, with some additional capacity provided by gas/oil as well as decommissioning approximately 1,000 MW of coal generation. A primary area of focus for the SERC utilities is adding new transmission lines and existing system upgrades over the next five years. Current transmission projects through 2013 are projected to have $11.8 billion in expenditures. Over the next 10 years, "planned transmission expansion at 100kV and above in SERC represents approximately 14.6 percent of all transmission expansion in the U.S."

ECONOMICS:

Missouri power customers are provided some of the least expensive energy in the country. This is principally linked to Missouri's use of coal generation. Tightening rules regarding sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) emissions will create the need for large capital improvements at plants leading to higher prices for users, needed to pay for these projects. This is occurring around the nation today. In the future, potential carbon regulations will impact prices but this is less eminent than SO_2 and NO_2 regulations, which are already moving forward. The reasons for these standards have been provided by the EPA and are linked to prevention of premature deaths, preventable sick days and $280 billion of healthcare benefits.

The condition of the existing power transmission systems is important to monitor and sources indicate that a national shortfall of $37.3 billion in investment is expected between now and 2020. Without the needed improvements, the probability of failure associated with wind storms and ice events increases for transmission infrastructure.

Utilities can create a more reliable business model through more efficient transmission systems. Creating an efficient system appears to be an opportunity being vetted currently. Transmission infrastructure is critical to creating a reliable energy distribution network for a day-ahead marketplace. With the establishment of a day-ahead marketplace, it appears that utilities and their clients could potentially benefit from these efficiency's as well as improve reliable energy delivery. Financial incentives and improvements to permitting speed and land access would help accelerate these projects.

Renewable energy in Missouri is moving forward and a Renewable Energy Standard has already been established. The development of these sources appears to be closely tied to the economic benefits of credits and other incentives associated with renewable energy sources. Without these incentives, many speculate that this market becomes less viable for prospective investors and power producers.

Natural gas is abundant in neighboring Kansas and is beginning to establish a marketplace that has proved reliable in the near term. This marketplace is tied to innovative methods of drilling and a strong demand. Infrastructure projects associated with gas delivery have proven to be difficult to permit due to environmental challengers, delaying the potential economic benefits of gas exports and the associated jobs. Gas is being used around the country for new power generation and also to replace decommissioned coal plants, due to its decreased emissions.

Given current trends, a national investment shortfall of $107 billion is expected by 2020. Eleven percent of this shortfall is new generation and 89 percent is transmission and distribution. The SPP and SERC are expected to have an investment shortfall of $2.4 billion and $29.7 billion, respectively, by the year 2020. This lack of investment is expected to reduce GDP by $70 billion and cost 529,000 jobs by the year 2020.

CONCLUSION:

Power customers in Missouri are currently benefiting from reliable and cheap energy. The state relies on power from multiple sources but largely coal. This infrastructure will need to expand and upgrade due to new demand, current age, and environmental standards. Wind energy has the potential to grow but could stall due to expiring incentives. The state delivers energy through a transmission network that is aging and needs to grow to meet the new renewable and gas sources. The power generation and delivery market is facing investment needs driven by new demand, environmental regulations, deteriorating infrastructure, expiring incentives, land acquisition restrictions and a lack of proper enticement to investment. Finding permitting and regulatory balance, coupled with investment solutions will require action by government, power providers and power users.

RESOURCES:

1. http://www.spp.org/publications/2010_SPP_Strategic_Plan.pdf.
2. http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=KS07R.
3. http://www.instituteforenergyresearch.org/state-regs/pdf/Missouri.pdf.
4. http://consumerenergyalliance.org/state-energy-profiles/missouri/.
5. https://www.midwestiso.org/AboutUs/Pages/AboutUs.aspx.
6. https://www.midwestiso.org/AboutUs/Pages/AboutUs.aspx.
7. http://www.serc1.org/Documents/SERC/SERC%20Publications/Information%20Summary/2011%20Information%20Summary%20Brochure%20(July%202011).pdf.
8. http://205.254.135.7/state/state-energy-profiles.cfm?sid=MO.
9. http://205.254.135.7/forecasts/archive/aeo11/source_nuclear.cfm.
10. http://www.asce.org/uploadedFiles/Infrastructure/Failure_to_Act/energy_report_FINAL2.pdf.
11. Energy Information Administration, State Energy Data System (www.eia.gov).

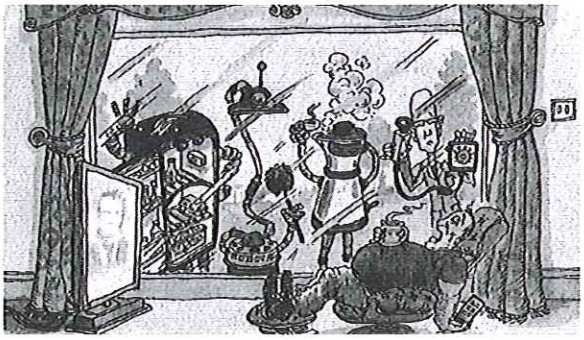
The Economist

The internet of things

Where the smart is

Connected homes will take longer to materialise than expected

Jun 11th 2016 | SAN FRANCISCO | From the print edition

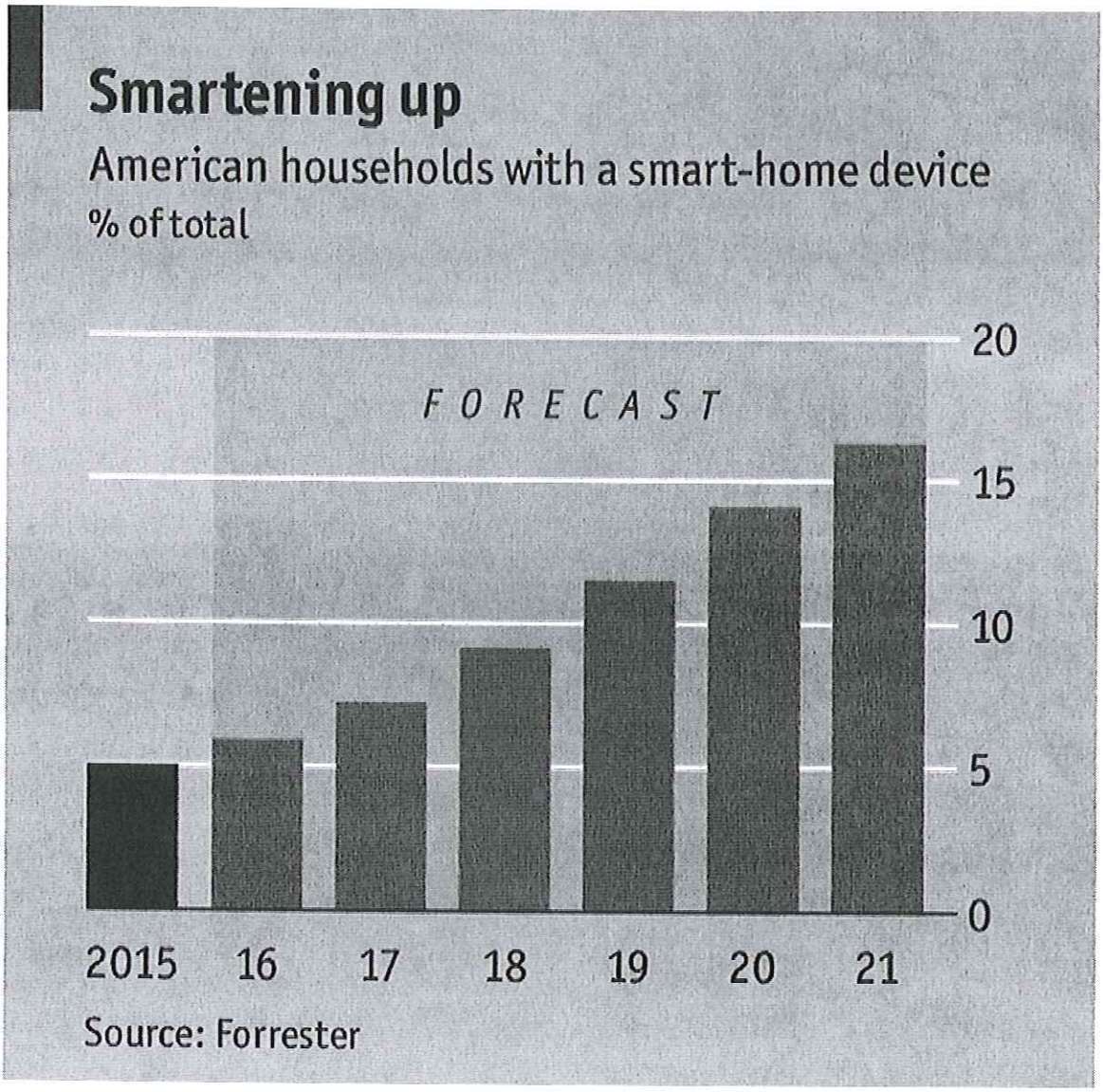


THE fanfare has gone on for years. Analysts have repeatedly predicted that the "internet of things", which adds sensors and internet capability to everyday physical objects, could transform the lives of individuals as dramatically as the spread of the mobile internet. Providers have focused on the home, touting products such as coffee pots that turn on when the alarm clock rings, lighting and blinds that adjust to the time of day, and fridges that send an alert when the milk runs out. But so far consumers have been largely resistant to making their homes "smart".

That's not for want of trying by tech firms, which have poured cash into their efforts to connect everyday objects to the internet. In 2014 Google made the biggest statement of intent so far, spending $3.2 billion to acquire Nest, a smart thermostat-maker, and $550m to buy Dropcam, which makes home-security cameras. Nest absorbed Dropcam; it is now one of the best-known smart-home brands. But it is also a warning about how long it will take for such gadgets to enter the mainstream.

Nest has undoubtedly disappointed Google. It sold just 1.3m smart thermostats in 2015, and only 2.5m in total over the past few years, according to Strategy Analytics, a research firm. For a couple of years the firm has mainly tweaked existing products rather than introducing new ones. That may explain why Tony Fadell, Nest's founder and boss, stepped down on June 3rd to take an advisory role at Google's parent company, Alphabet (see article (http://www.economist.com/news/business/21700404-alphabet-still-working-out-how-treat-its-internal-startups-alpha-minus)). Mr Fadell, a former executive at Apple and designer of the iPod, failed to bring his magic touch to the smart home.

Nest's problems are symptomatic. Only 6% of American households have a smart-home device, including internet-connected appliances, home-monitoring systems, speakers or lighting, according to Frank Gillett of Forrester, a research firm. Breakneck growth is not expected; by 2021 the number will be just over 15% (see chart). Too few consumers are convinced that the internet has a role to play in every corner of their lives. A survey conducted in Britain by PricewaterhouseCoopers, a consulting firm, found that 72% of people have no plans to adopt smart-home technology in the next two to five years and that they are unwilling to pay for it. Last year consumers globally spent around $60 billion on hardware and services for the smart home, a fraction of the total outlay on domestic gadgets.



Economist.com

There are several reasons for muted enthusiasm. Businesses have an incentive to embrace the internet of things: there are cost savings to be had from embedding sensors in equipment and factories, analysing the data thus produced and improving efficiency. A lot of smart devices for the home, in contrast, remain "fun but not essential", says Adam Sager of Canary, a startup that makes cameras that lets people monitor what is happening in their house.

Many smart gadgets are still too expensive. One of Samsung's smart fridges, with cameras within that check for rotting food and enable consumers to see what they are short of while shopping (through an app on their phone), sells for a cool $5,000. People who can afford that probably don't do their own

shopping. Appliances such as fridges are also ones that households replace infrequently: that slows the take-up of new devices.

The technology is not perfect yet, either. The smartphone, the link between the customer and smart-home device, has raised consumers' expectations, explains Jamie Siminoff, the boss of Ring, a startup that makes a doorbell that can be answered remotely. Smartphones have trained users to expect a level of quality and seamless ease of use that smart-home devices struggle to replicate. And a lack of standardisation means that gadgets from different firms cannot communicate with each other.

There are exceptions. Devices that are easy to install and offer obvious benefits are gaining in popularity, such as motion sensors that send alerts when windows and doors are opened and cameras to monitor activity. Some devices, such as smart smoke detectors, are in homes because insurance companies offer financial incentives for using them. The smart-home sector is vibrant with startups and big firms betting that the hesitancy is temporary. But consumer apathy has forced firms to rethink how they might woo customers.

Perhaps the biggest surprise is that Amazon, which failed miserably in its ambition to develop a smartphone, is showing the way. Amazon Echo is a smart speaker that can recognise and respond to voice commands. It shares information about the weather and sports scores, plays music and turns lights on and off. The device, which costs around $180, is not yet a big seller. Amazon does not release sales figures, but Strategy Analytics estimates that fewer than 1m Echos have been sold since it was released in November 2014. Yet the Echo is the talk of Silicon Valley.

Talk to your appliance

An interface that relies on voice commands could overcome one of the drawbacks of the piecemeal approach to the smart home, by becoming the standard integrator of all the other bits of smart kit. Echo is open to outside developers, who can come up with all manner of devices and services that hook up with it. Echo's success may have come as a surprise, but competitors have cottoned on that it may be a crucial piece of equipment. Google has announced plans to build a stand-alone hub like Echo, called Google Home, which will also rely on voice commands.

Apple is also expected to announce new smart-home capabilities: there are rumours it could launch a stand-alone hub in the Echo vein at its annual developers' conference on June 13th. Its smart-home platform, called HomeKit, has been a failure so far. That Apple, despite its large base of affluent acolytes, has not yet cracked the smart home is a sign of its difficulty, points out Geoff Blaber at CCS Insight, which tracks mobile-industry trends.

Each tech giant has a different reason for trying to overcome the indifference of consumers, and to embed itself more deeply in the home. The Echo can help Amazon learn how people spend their time, and make it easier for them to spend money too by suggesting things they might buy. Google, whose main business is advertising, also wants to draw from a fresh well of data; by learning as much about users as possible, it can target them with appropriate ads. Apple, with a track record of simplifying and

creating ecosystems where others before it could not, wants its devices to be the gateway through which people go to organise their lives.

If the tech giants retain their ambition to sit at the centre of the smart home, uncertainty prevails over where the profits lie. "It remains unclear what the economic model for the smart home will be," says Andy Hobsbawm of Evrythng, an internet-of-things platform. Some firms will try to make enough profit just from hardware. Others will try to sell services, such as archiving security videos, as well as devices, and charge a fee. The products that fill houses are diverse, personal and durable. That should give plenty of companies a shot at lodging themselves in the home—but only when consumers decide to put out the welcome mat.

From the print edition: Business