National Perspectives on State Regulatory Oversight of Geothermal Heat Pump Installations

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Sponsors

- The Geothermal Heating and Cooling Systems State Regulatory Oversight Survey was funded in a collaborative effort

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Survey Compiled by:

Industry Insights, a research and consulting firm that specializes in conducting industry surveys and customized research services. Conducted, tabulated and analyzed the results of this report.

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Survey Methodology

- The survey instrument used for this study was an online questionnaire that primarily requested geothermal heating and cooling regulatory data.
- An email containing a link to the online survey was sent to state contacts in mid-January 2010. If multiple contacts existed for a state, all contacts were copied on one email to encourage collaboration and discussion.
- The email also instructed the recipient to forward the survey link on to others whom may be were more qualified to answer the questions.
- To encourage participation, reminder emails were sent by both Industry Insights and the associations funding the study.

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Survey Methodology

- Survey submissions were collected through early April 2010 with 34 states responding to at least a portion of the survey. Before the results were finalized, each respondent's data was sent back to them in report-format for verification.
- All data were checked both manually and by a specially designed computer editing procedure.
- Final results were tabulated and the report was completed in early May 2010.
- Respondents to the survey were sent the final report, which was offered as an incentive to participate.

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Interpreting the Results

- Throughout the individual state data an “X” denotes the response the state gave for all frequency questions.
- Most of the numeric measures and statistics included in the “All States” section of this study are reported on the basis of medians rather than arithmetical averages or means. Unlike the mean, the median is not distorted by a few unusually high or low values that may exist in the sample due to special circumstances. The "median" figure represents the mid-point of the figures for a particular measure, with one-half of the respondents reporting figures above it and one-half below. Each median has been independently selected from its own array of figures.
  - **Smallest Largest**
  - **Number Number**
  - **Reported Typical Reported**
  - **Lower 25% of Reported Figures**
  - **Middle 50% of Reported Figures (or Middle Range)**
  - **Upper 25% of Reported Figures**
  - **Median**
- All open-ended/text-based questions were removed from the “All States” section of the report.

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Geothermal Heating and Cooling Systems State Regulatory Oversight Survey

- Most complete, accurate, and up-to-date information for geothermal system regulation available anywhere at this time.
- The report is designed to allow readers to easily compare state-by-state regulations, as well as aggregate data on all responding states.

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Geothermal Heating and Cooling Systems State Regulatory Oversight Survey

- 637 page full-report
- 34 responding states

- Available from NGWA
  - Free to regulatory personnel
  - Free to other NGWA members
  - $1,000 to non-members and non-regulators

34 States Responded (blue)

Survey Methodology

- Data was collected on nine geothermal system configurations. They were:
  - 1. Open loop – single well for water withdrawal, water returned to a surface source
  - 2. Open loop – single well for water withdrawal, water returned to a second well
  - 3. Standing column – single well for water withdrawal and water return
  - 4. Closed loop – vertical boreholes
  - 5. Closed loop – subsurface trenched, or other configuration, but not vertical boreholes
  - 6. Closed loop – surface water body emplacement
  - 7. Direct exchange (DX) – vertical boreholes
  - 8. Direct exchange (DX) – subsurface trenched, or other configuration, but not vertical boreholes
  - 9. Concentric pipe systems (heat exchange fluid flows to the bottom of the hole through a small diameter inner pipe)

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Open Loop – Single Well (Open 1)

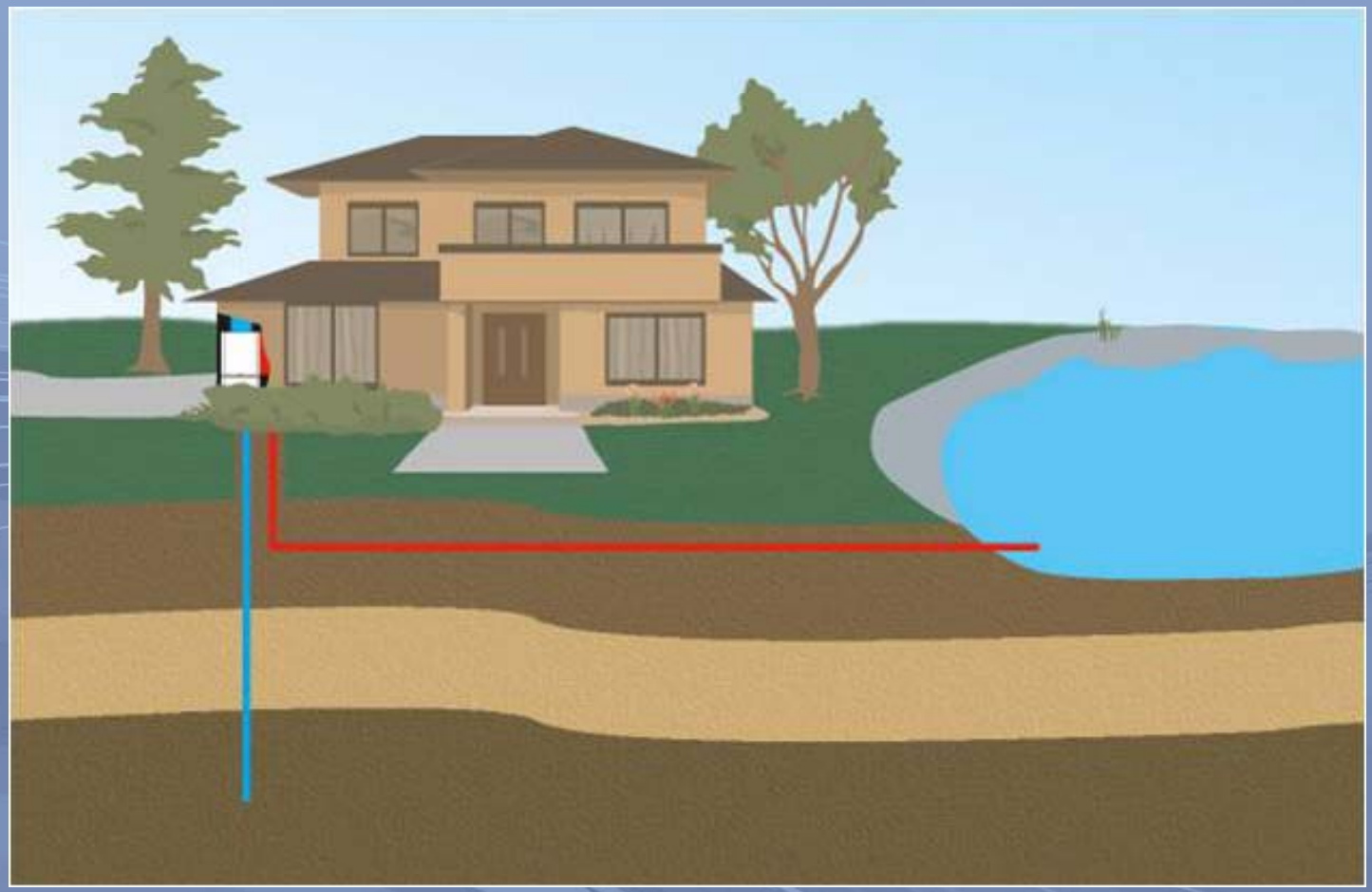

Image courtesy of: International Ground Source Heat Pump Association

Open Loop – Two Wells (Open 2)

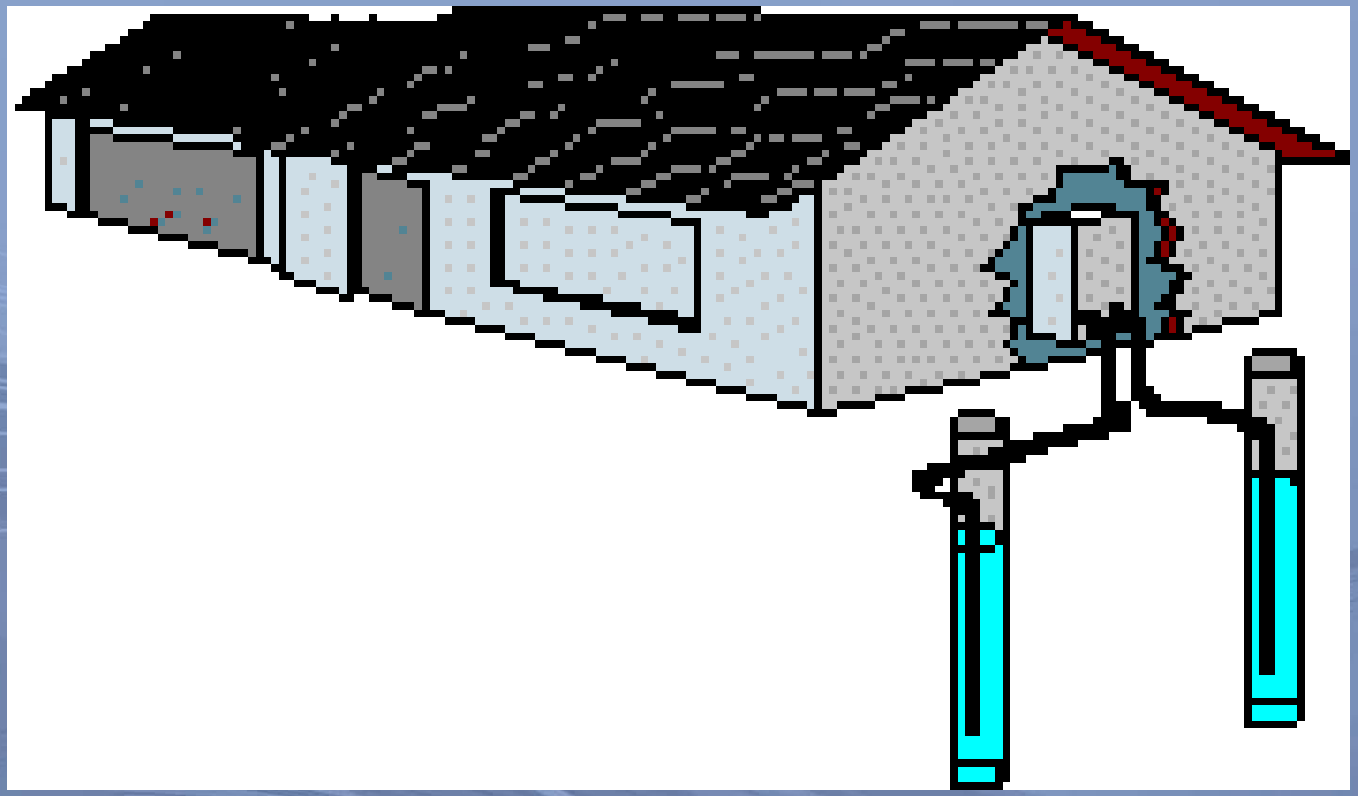

Image courtesy of: Geothermal Energy Organization

Standing Column (Stand Col.)

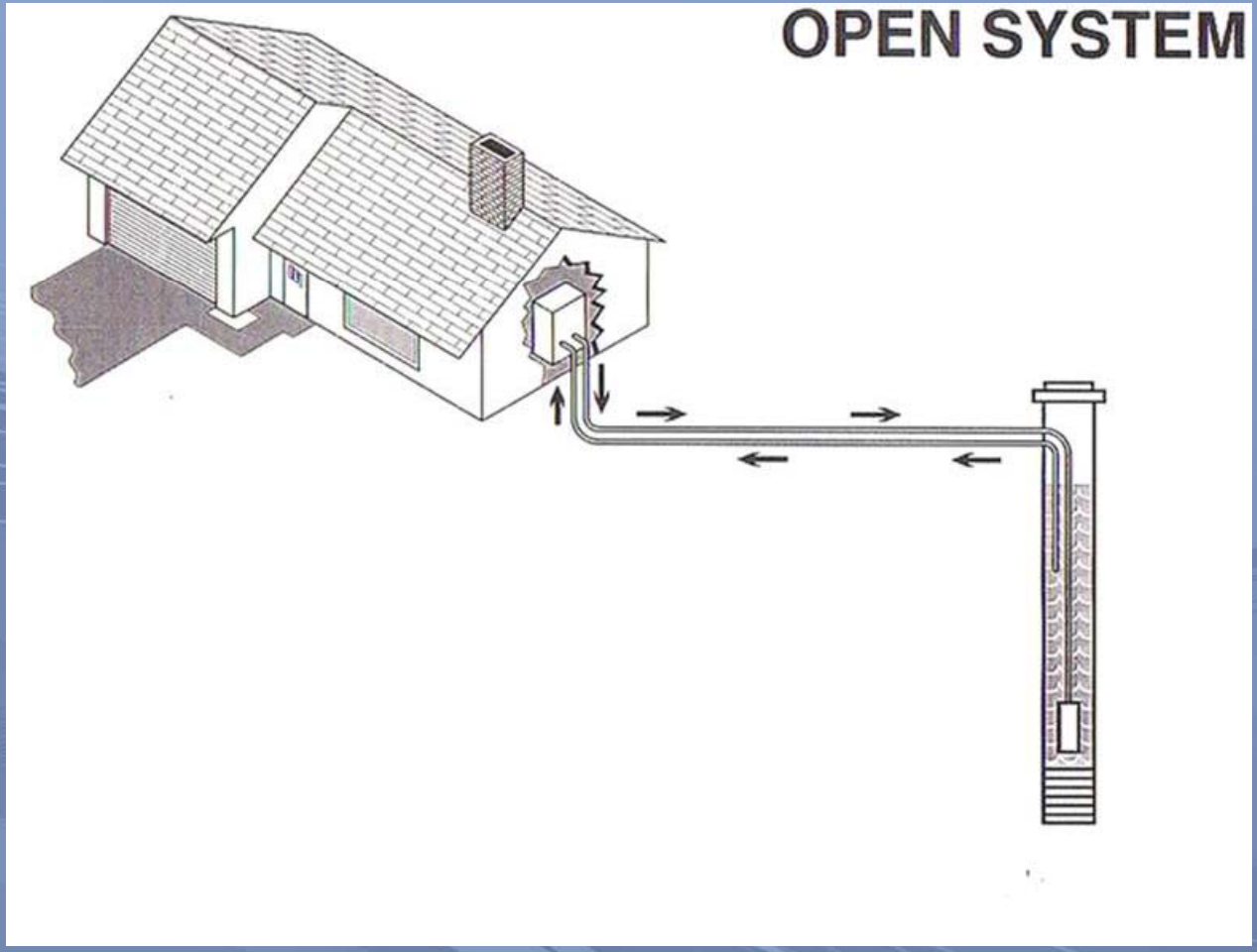

Image courtesy of: Geothermal Energy Organization

Closed Loop – Vertical Borehole
(CL 1)

Image courtesy of: Geothermal Energy Organization

Closed Loop – Subsurface Trenched
(CL 2)

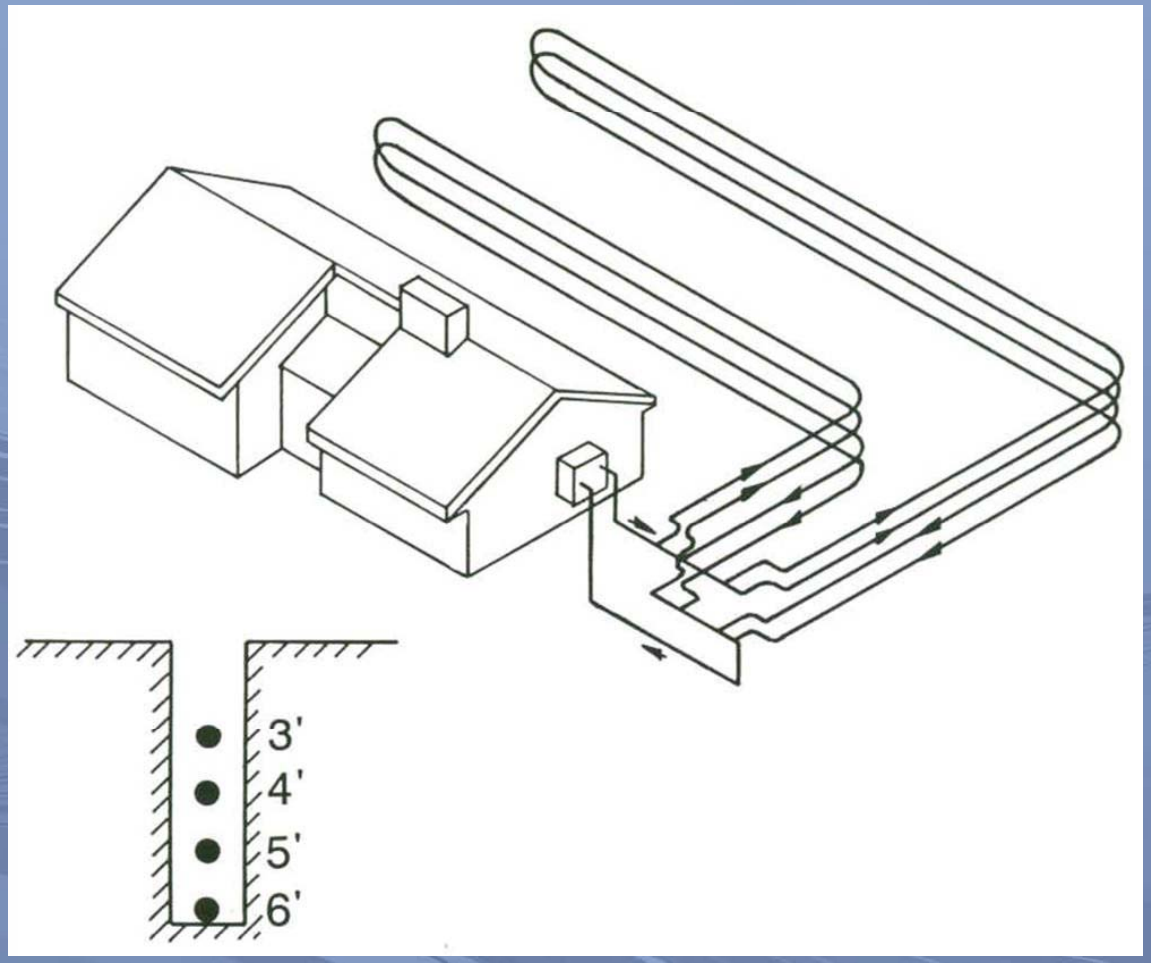

Image courtesy of: International Ground Source Heat Pump Association

Closed Loop – Surface Water (CL 3)

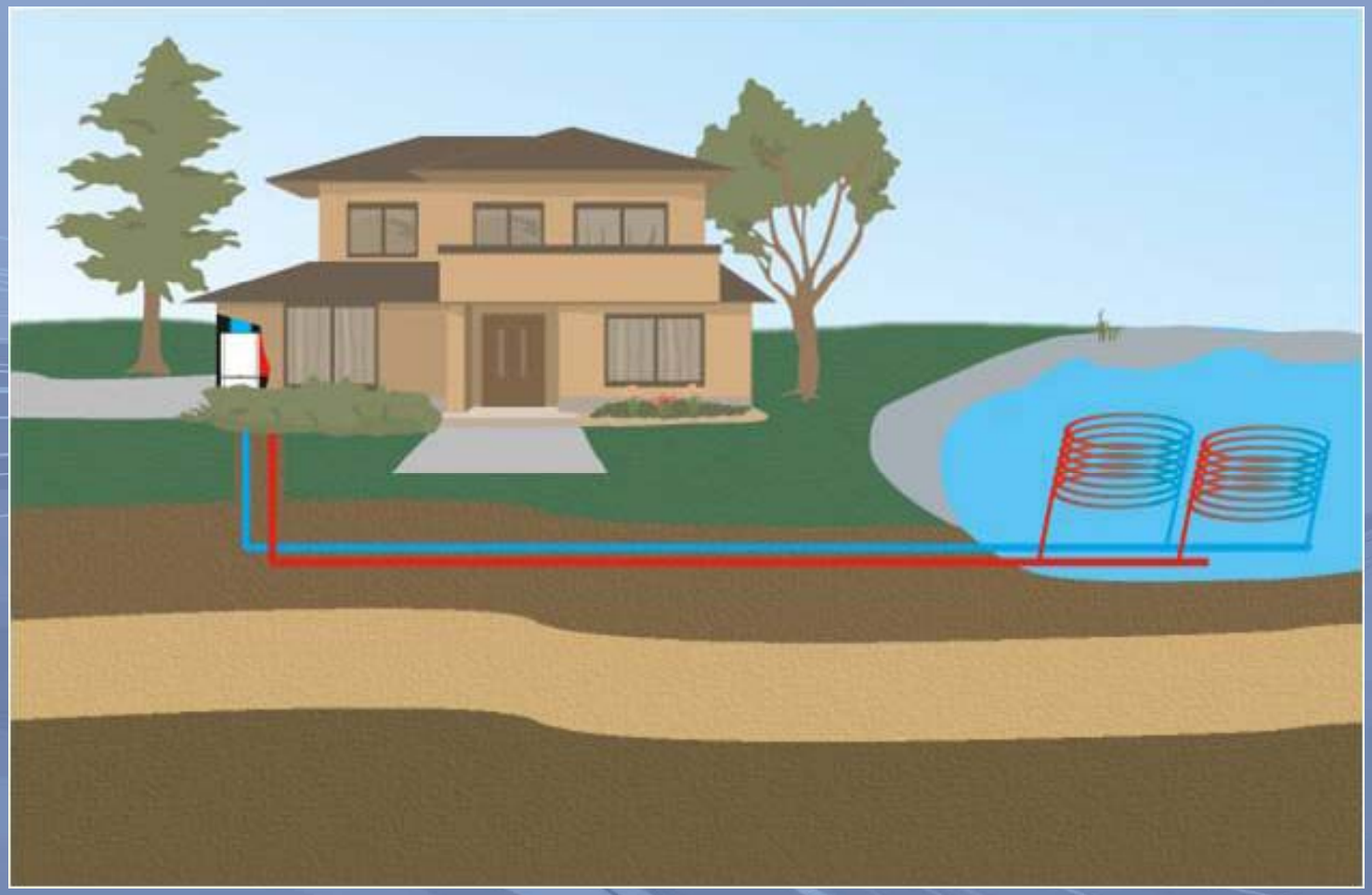

Image courtesy of: International Ground Source Heat Pump Association

Direct Exchange (DX 1 & 2)

Image courtesy of: Earthlinked Technologies

Concentric (Con.)

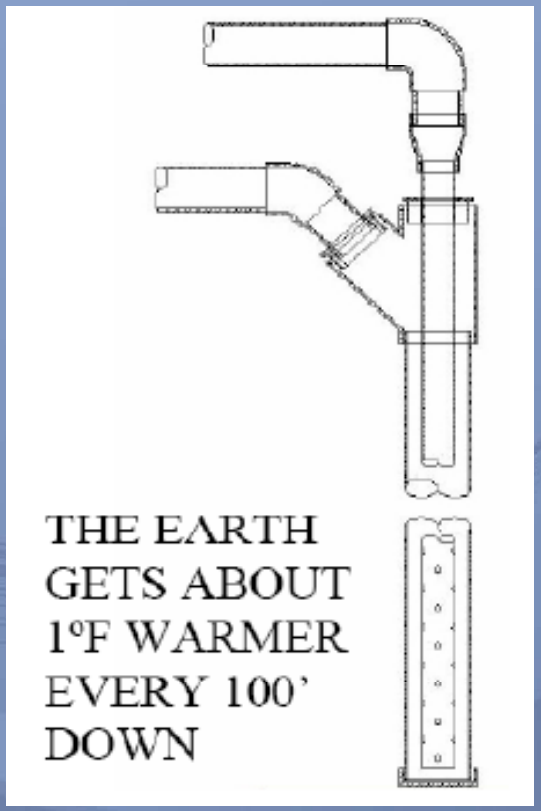

Image courtesy of: *Jim Godbout Plumbing & Heating Inc., Biddeford, Maine*

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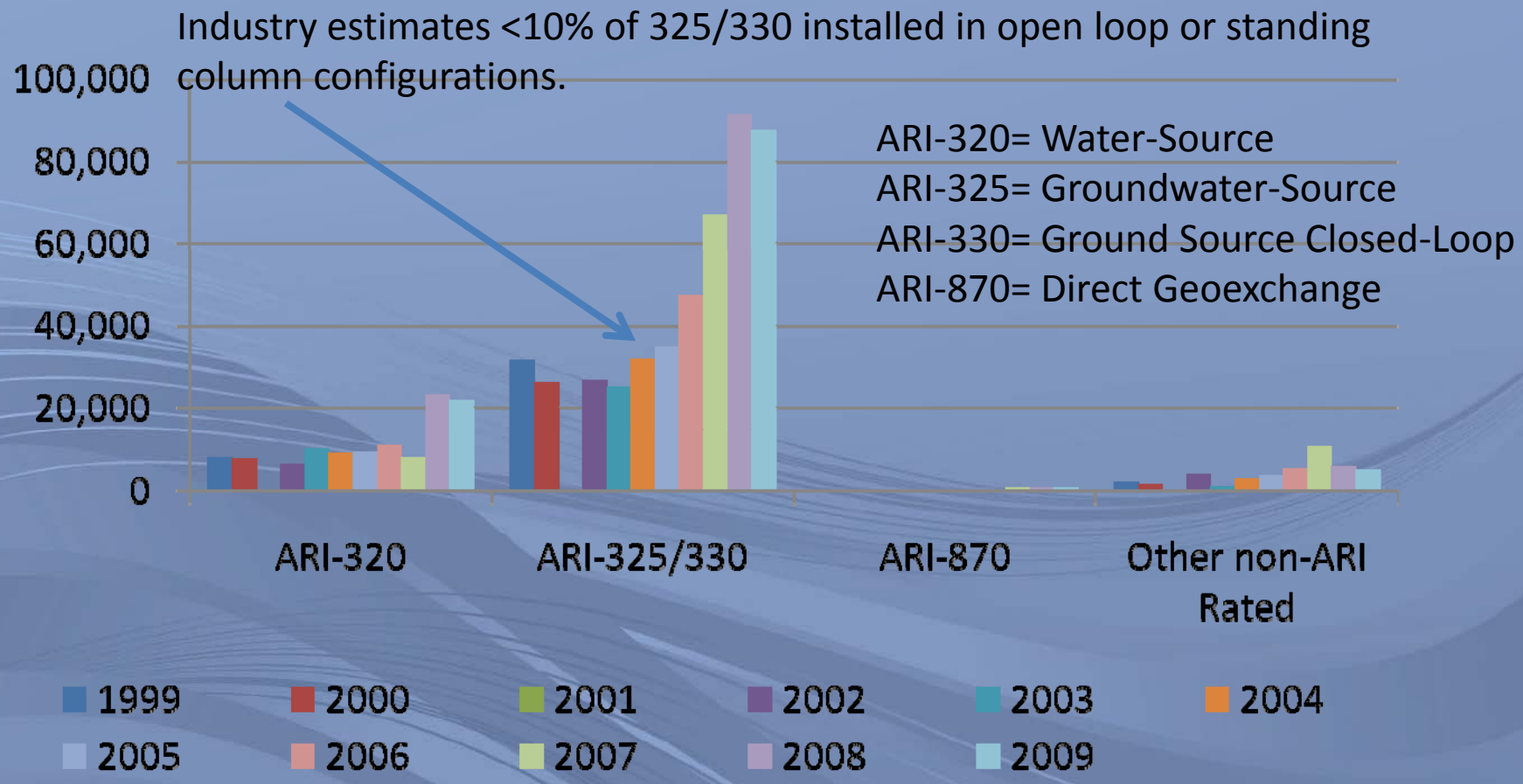
Ground- and Groundwater-source Heat Pump Shipments: 1999 - 2009



Source: U.S. Energy Information Administration, December 2010

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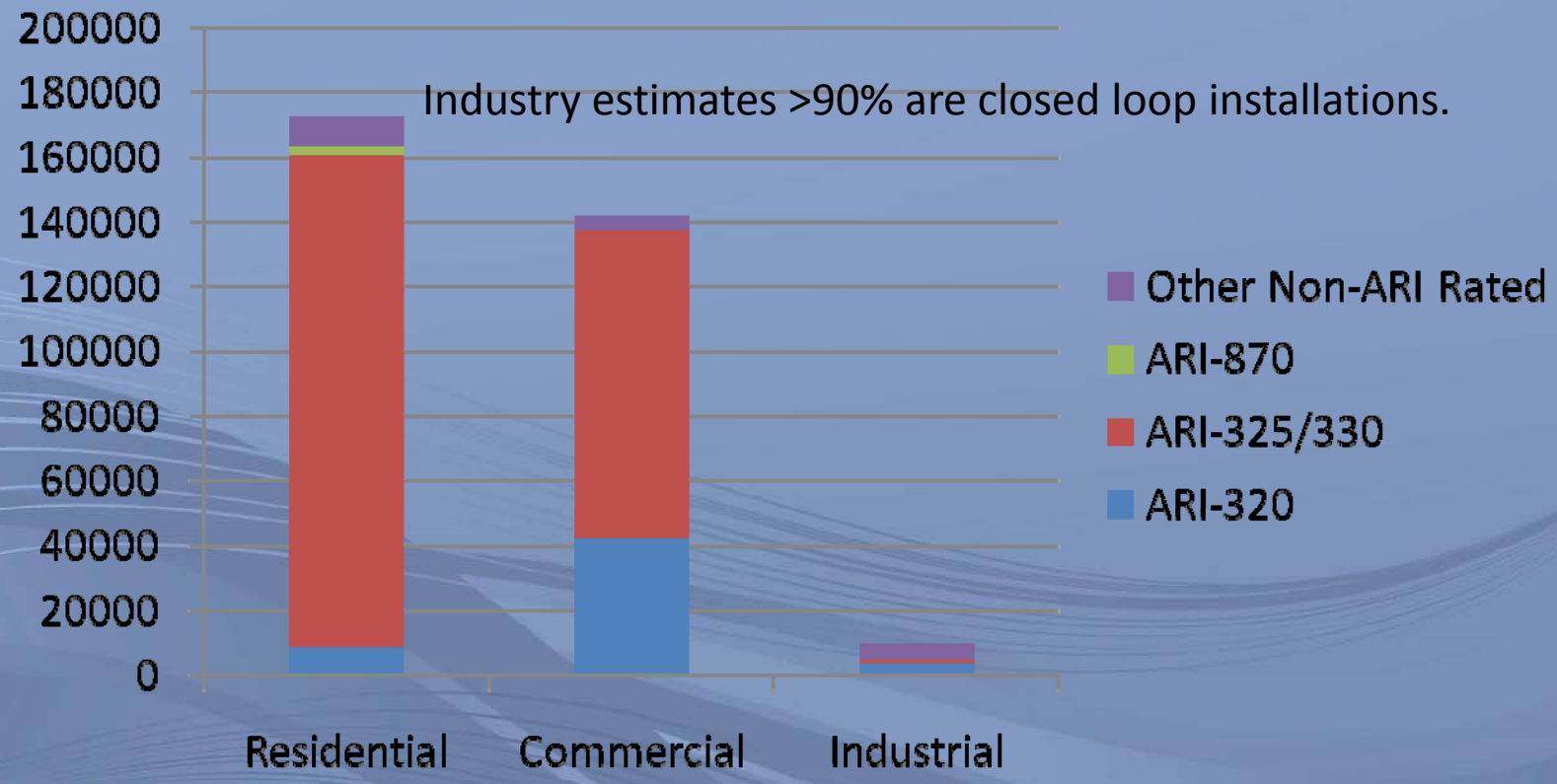
Geothermal Heat Pump Domestic Shipments by Sector and Model Type, 2009 (Rated Capacity in Tons)



Source: U.S. Energy Information Administration, December 2010

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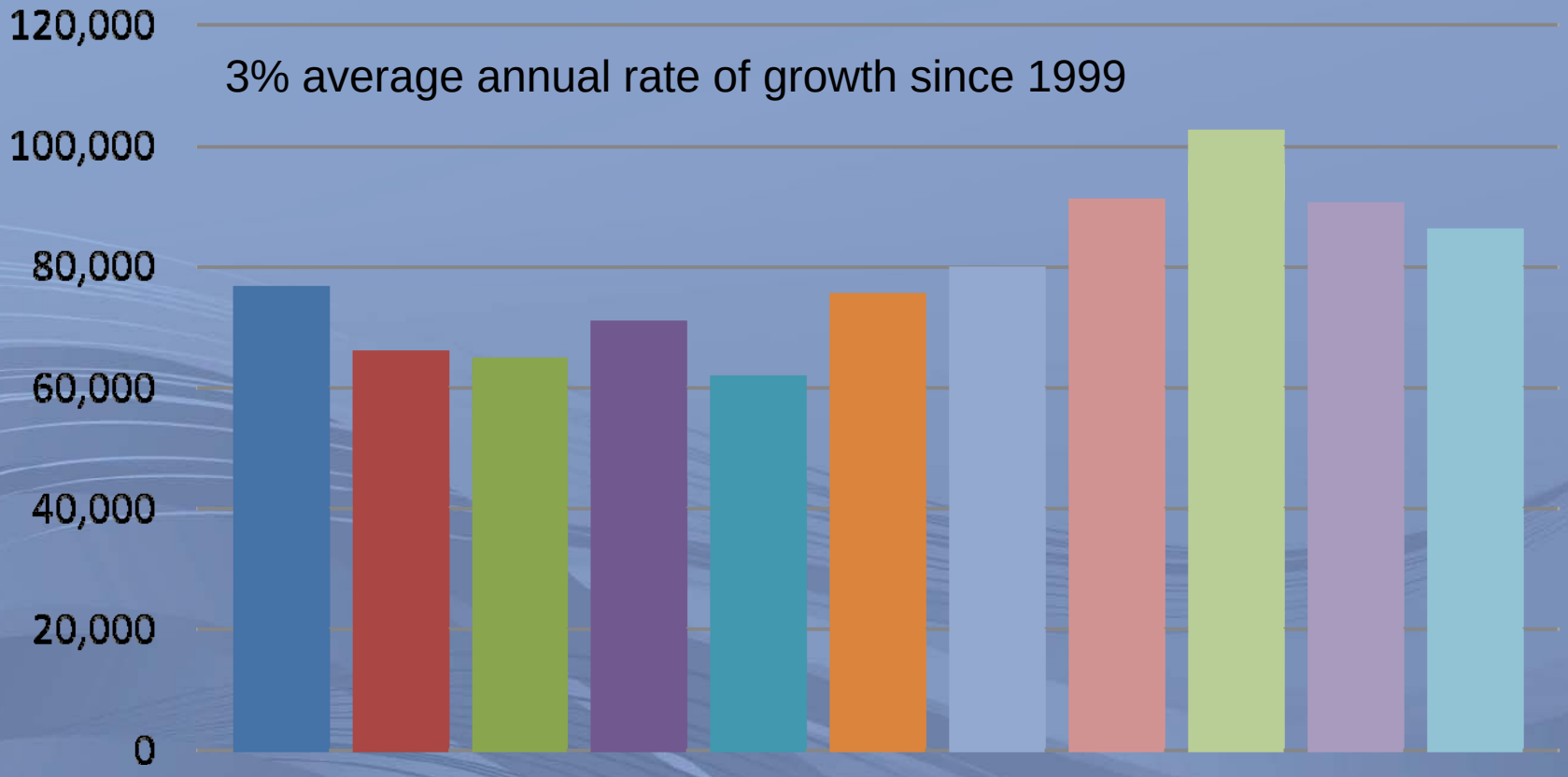
Ground and Groundwater-sourced Heat Pump Unit Shipments: 1999 - 2009



Source: U.S. Bureau of the Census, Current Industrial Report MA333M

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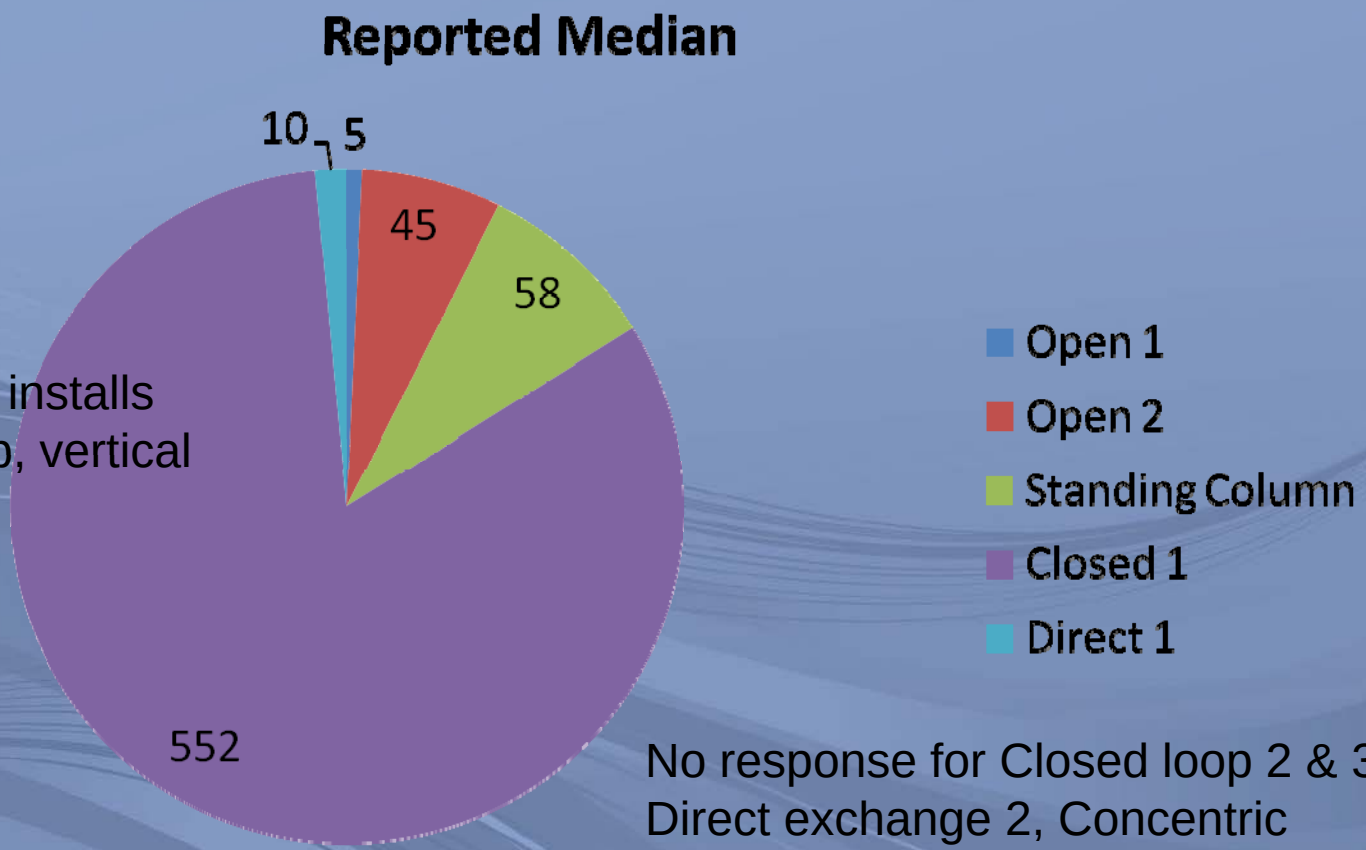
Market Share by System Configuration: This Survey Only!



82% of reported installs were closed loop, vertical boreholes.

No response for Closed loop 2 & 3; Direct exchange 2, Concentric

No. of Systems over 5 Years (median)

Open 1	Open 2	Stand Col.	CL 1	CL 2	CL 3	DX 1	DX 2	Con.
5	45	58	552	nr	nr	10	nr	nr
0.75%	6.7%	8.7%	**82%**	nr	nr	1.5%	nr	nr

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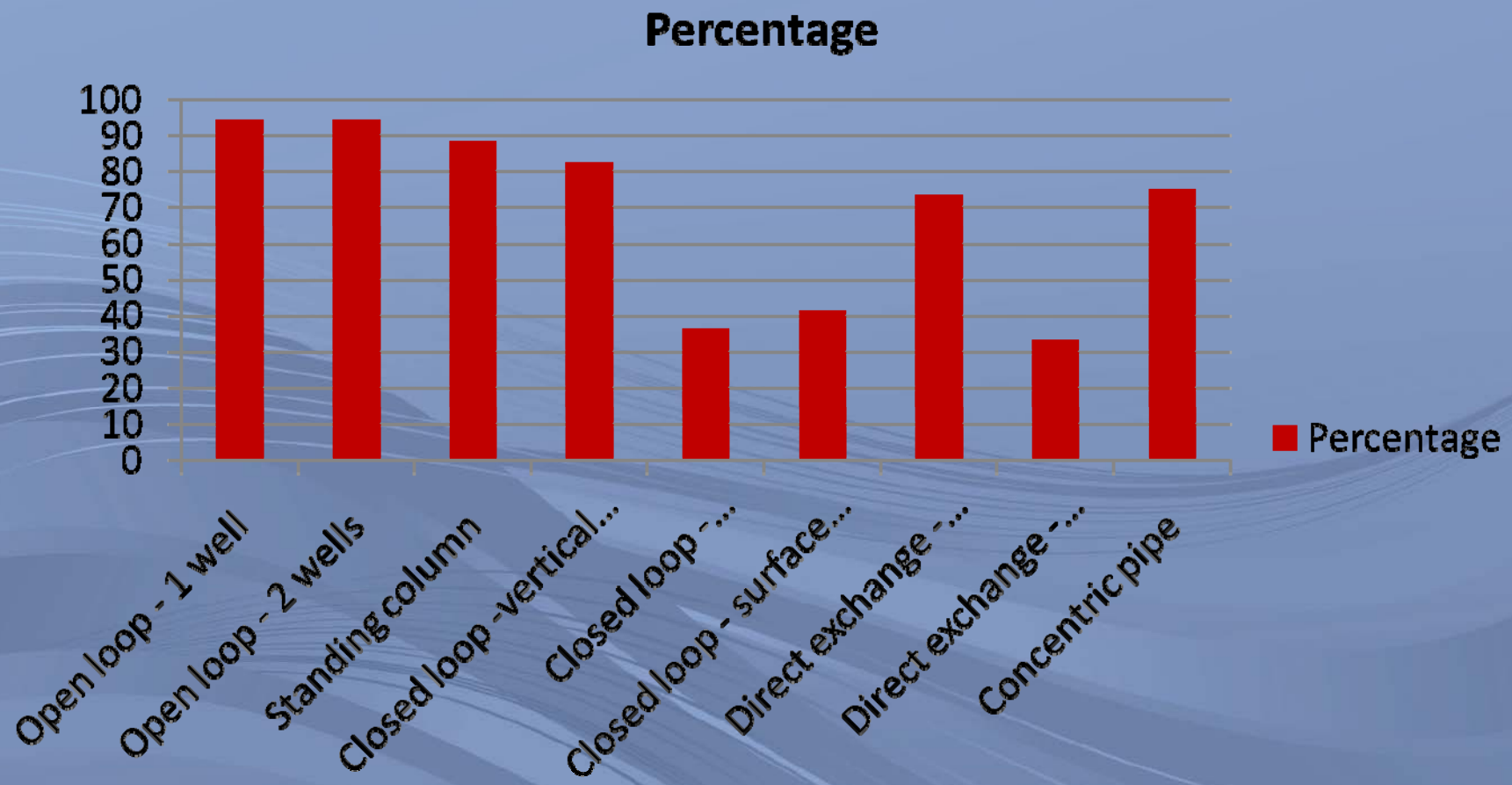
Percentage of Geothermal System Configurations Regulated by Responding States



Water well boards are the state board most likely to oversee geothermal system installation.

Which state boards have oversight?

Board	Open 1	Open 2	Stand Col.	CL 1	CL 2	CL 3	DX 1	DX 2	Con.
Building	0	0	0	6	11	11	0	0	0
Plumbing	0	0	0	6	0	0	0	0	0
Electrical	0	0	0	0	0	0	0	0	0
Water Well	**67**	**70**	**69**	**79**	**44**	**30**	**67**	**56**	**70**
HVAC	5	5	5	12	10	10	6	11	7

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Drilling professions most likely to be required to have a license among the responding states.

License required?

Profession	Open 1	Open 2	Stand Col.	CL 1	CL 2	CL 3	DX 1	DX 2	Con.
Design	27	27	29	37	37	12	36	20	31
Drilling	**92**	**96**	**92**	**91**	37	22	**90**	43	**89**
GW HP	59	55	59	44	43	25	47	33	40
Construction	41	50	50	66	**67**	**50**	59	**62**	59
System Operator	25	25	25	20	29	29	23	33	21

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Construction permits and fees most commonly requested for geothermal work.

Permits and Fees?

Permit or Fee	Open 1	Open 2	Stand Col.	CL 1	CL 2	CL 3	DX 1	DX 2	Con.
Construction Permit & Fee	**50**	**52**	**52**	**42**	**38**	29	**44**	**43**	**44**
Geothermal Permit & Fee	37	36	35	33	29	25	27	17	20
Geothermal Design OK'd & Fee	22	19	21	13	25	14	15	29	14
Operate Permit & Fee	33	29	30	17	22	22	27	25	19
Geologic Record	0	0	0	4	27	**67**	5	30	5

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Water quality and water quantity permits most frequently requested.

Environmental Permits or Registrations?

Permit or Fee	Open 1	Open 2	Stand Col.	CL 1	CL 2	CL 3	DX 1	DX 2	Con.
Volumetric flow rates	50	48	**47**	0	0	0	0	0	7
Well depths	15	14	5	6	0	13	7	0	0
Number of wells	6	5	6	**12**	0	0	8	0	0
Heat load	32	15	11	6	0	**25**	8	0	7
Water quality	**68**	**53**	33						

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Less than a third of the states require installer training of any form for any profession associated with geothermal installations.

Geothermal Installer Training?

Profession	Open 1	Open 2	Stand Col.	CL 1	CL 2	CL 3	DX 1	DX 2	Con.
Design	0	0	0	0	0	0	0	0	0
Drill	**27**	**35**	**29**	**32**	0	9	**30**	13	**26**
GHP	10	18	14	17	**14**	**11**	13	17	13
Construction	9	9	10	11	11	10	13	13	13
Operator	5	5	5	6	13	0	7	17	7

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Environmental impacts from thermal exchange are generally not monitored.

Standards & Regulations?

Regulation	Open 1	Open 2	Stand Col.	CL 1	CL 2	CL 3	DX 1	DX 2	Con.
Construction	**89**	**93**	**92**	**100**	**89**	**64**	95	**88**	**100**
Operation	48	50	44	37	38	22	44	57	44
Abandon.	**89**	**93**	**92**	**100**	**88**	40	**100**	**86**	**100**
Heat transfer to earth calculation	4	4	5	5	13	9	6	14	6
Limits to earth temp ranges over lifecycle	9	8	9	10	0	10	12	14	13
R-22	36	39	43	50	**75**	50	65	71	50
R-401A	36	39	43	50	67	50	59	**75**	50

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Setback distances are more often regulated than spacing of the heat exchange tubing.

Specific Criteria?

Criteria	Open 1	Open 2	Stand Col.	CL 1	CL 2	CL 3	DX 1	DX 2	Con.
Location on property	50	62	60	57	50	40	53	57	53
Setback	**73**	**80**	**88**	**68**	**71**	33	68	67	67
Depth	8	16	9	5	14	0	6	0	7
Formations penetrated	25	32	30	42	43	33	35	33	32
Heat transfer fluids	33	35	41	70	71	50	71	67	63
Water additives	64	67	70	57	43	33	61	50	56
Spacing of loops	16	20	23	20	14	11	13	0	6
Materials	56	64	68	**80**	63	**67**	**78**	**71**	**71**

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